FORM NO. 28-650 (11-66)

165

DOUGLAS

MISSILE & SPACE SYSTEMS DIVISION
DOUGLAS AIRCRAFT CO., INC.

ENGINEERING LABORATORIES & SERVICES
TECHNICAL MEMORANDUM

TO: R. M. Gunn, A3-860

FROM: J. P. Loef, A-270

SUBJECT: LO_2 CHILLDOWN SYSTEM SHUTOFF VALVE, SCN 1A49965-521, FORMAL QUALIFICATION TEST

COPIES TO: J. H. Brettnacher, G. R. Schroeder, I. M. Williamson, A-270; P. Sellers, A2-260; J. C. Byers, J. Hilman, F. S. Mayer, Jr., E. T. Oddo, J. K. Janoung, R. P. Shepherd, V. B. Thomas, C. R. Tiedeman, D. L. Trader, A3-860; C.W. Wilson, A3-860(16)

CATALOG NO. PDL 81272

REPORT NO. TM-DSV4B-ENV-R5924 Rev A

DATE 28 April 1967 7/21/67

REQUESTED BY R. M. Gunn, A3-860

E.W.O. 27903 TCD 1T07782

TEST PLAN & ITEM NO. SM-41412, FQ-F-14A

SALES ORDER 5769-6404

CLASSIFICATION OR RESTRICTION: Unclassified

PREPARED BY: K. C. Tolides, A-273

APPROVED BY: J. H. Brettnacher
J. H. Brettnacher, Acting Section Chief
Environmental Test
Environmental Laboratories Branch

APPROVAL SIGNATURES CERTIFY THAT ALL REQUIREMENTS OF REPORT HAVE BEEN MET INCLUDING THE REPORTING OF NEW TECHNOLOGY/REPORTABLE ITEMS PER SPB'S 92 AND 93. DISCLOSURES ARE MADE ON FORMS 25-207 AND 25-207-1.
NEW TECHNOLOGY: ☐ IS CONTAINED IN THIS REPORT, ☒ IS NOT CONTAINED IN THIS REPORT.

ABSTRACT:

This document details the tests performed by Beech Aircraft Corporation, Boulder, Colorado, for the Douglas Aircraft Company, Inc., on the LO_2 Chilldown System Shutoff Valve, Specification Control Drawing 1A49965-521, Revision Y. Testing was discontinued upon completion of the vibration and mechanical shock tests due to excessive internal actuator leakage. The valve had satisfactorily completed pre-test inspection, proof pressure, leakage, functional, and repeat cycle prior to the post vibration and shock leakage-test failure.

DESCRIPTORS
Saturn S-IVB/V
LO_2 Valve
Chilldown
Shutoff

REVISION TO REPORT NO: TM-DSV4B-ENV-R5924

FORM 28-600 (3-67)

CHG LTR	DATE REVISED	PAGES REVISED	BRIEF DESCRIPTION OF CHANGE AND REASON	REVISED BY	APPROVED BY
A	7/21/67	D-12	Added accelerometer numbers; 1,2,3,4,5,6, and 7	J.R. Schulz	
		D-13	Added note, description of accelerometers		
		D-14	Same as D-13		
		D-15	Same as D-13		
		D-16	Same as D-13 Added: Radial axis Accelerometer #1		
			Reason for change: To add required information.		

PREFACE

This report was prepared by the Douglas Aircraft Company, Inc., for the National Aeronautics and Space Administration, Marshall Space Flight Center, under Contract NAS7-101 and contains detailed information concerning the testing of the LO_2 Chilldown System Shutoff Valve, Specification Control Drawing 1 49965-521, Revision Y.

The test specimen was subjected to an inspection and to non-destructive environmental tests; i.e: pre-test inspection, proof, leakage, functional, cycling (low, high, and ambient temperature), and vibration and mechanical shock. The specimen failed the leakage tests which followed vibration and shock. This failure is reported in Douglas Failure and Rejection Report A151137.

All functional and environmental tests were witnessed by a representative of Douglas Quality Control. These tests were conducted by the Beech Aircraft Corporation, at Boulder, Colorado, during the period from October 12, 1966 to October 31, 1966. Teardown inspection and failure analysis were conducted at Fairchild-Hiller, Manhattan Beach, California.

CONTENTS

CONTENTS (Cont'd)

ADDENDA

1.0 INTRODUCTION

1.1 Purpose of Test

The purpose of this formal qualification test was to demonstrate to the National Aeronautics and Space Administration, Marshall Space Flight Center, the ability of the LO_2 Chilldown System Shutoff Valve, Specification Control Drawing LA49965-521, Revision Y, to meet the requisites of Test Requirements Drawing LT07782, Revision C, when tested according to Test Procedure LT07783, Revision D.

The tests were authorized under Formal Qualification Test Program SM-46532, Item FQ-F-14[illegible], and General Test Plan SM-41412, Item FQ-F-14[illegible].

1.2 Description

The LO_2 Chilldown System Shutoff Valve, Douglas P/N LA49965-521, shown on addendum pages B-1 and B-2, is a normally open, pneumatically operated valve. It has one inlet and one outlet port, two sensing ports on the outlet side, and an actuation pressure port. An electrical connector, with leads to internally mounted switches, gives indication of valve position to the logic and fail-safe control circuits.

The valve is located between Douglas stations 150 and 160 of the DSV-4B IVB stage of the Saturn IB/V space flight vehicle.

1.3 Function

The valve is used to shut off the flow of liquid oxygen in the chilldown system during firing of the stage engines or during fail conditions. Actuation of the valve is effected by a helium control module that is controlled by logic and fail-safe signals.

2.0 TEST SPECIMEN, EQUIPMENT, AND INSTRUMENTATION

2.1 Test Specimen

One Production LO_2 Chilldown System Shutoff Valve Assembly, identified as follows:

2.1 Test Specimen (Cont'd)

Douglas part number 1A49965-521, Revision Y

Vendor - Fairchild-Hiller, Manhattan Beach, California

Vendor part number 64-401-05

Vendor serial number 0201

Specimen number 1

2.2 Equipment and Instrumentation

A detailed list of the actual equipment and instrumentation used is included as Addendum E of this report. Test equipment and instrumentation used in performance of the test were current in certification and were within the tolerances specified in the test requirements drawing.

3.0 TEST REQUIREMENTS

3.1 Environmental Tolerances

The maximum allowable deviations from the applicable environmental requirements were as follows unless otherwise specified:

a.	Temperature	±10°F (below -100°F) ±5°F (-100° to +250°F)
b.	Altitude	±5% (equivalent feet)
c.	Humidity	+5%, -0%
d.	Vibration (Sinusoidal)	±5% frequency ±10% amplitude
e.	Shock	±15% amplitude ±20% duration
f.	Pressure	±3% psig static ±5% psig dynamic
g.	Flow	±10% pounds per second
h.	Acceleration	±10% gradient
i.	Load	±5% of applied load
j.	Angularity	±0.5 degree
k.	Linearity	±1% stroke
l.	Vibration (Random)	±3 db when measured with a 50 cps filter

3.2 Instrumentation Tolerances

The maximum allowable error for the measurement equipment used in the test program was as follows unless otherwise specified:

a.	Temperature	±5°F (Below -100°F) ±2°F (-100° to +250°F)
b.	Altitude	±2%
c.	Humidity	±2%
d.	Vibration	±2.5% frequency ±8% amplitude
e.	Shock	±12% amplitude ±10% duration
f.	Pressure	±1.5% psig static ±3.0% psig dynamic
g.	Flow	±5% pounds per second
h.	Angularity	±0.25 degree
i.	Linearity	±0.5% stroke

3.3 Standard Conditions

3.3.1 Ambient Room Conditions

Unless otherwise specified, all tests were conducted at ambient room conditions. Ambient room conditions are defined as follows:

a.	Temperature	70 (±25)°F
b.	Relative Humidity	90% or less
c.	Pressure	30 (±2) inches Hg

When tests were performed at conditions different from the above values, proper allowance, when necessary, was made in the test results for the difference in the system condition. Ambient room conditions were recorded periodically during each test.

3.4 Temperature Stabilization

Stabilized temperature is defined as the state at which further temperature change occurs at a rate no greater than 1°F per minute.

3.4 Temperature Stabilization (Cont'd)

When tests were conducted at temperatures lower than -250°F, the LO_2 Chilldown System Shutoff Valve was temperature stabilized by flowing the test medium or an acceptable substitute through the interior of the specimen.

4.0 TEST PROCEDURE

The following list specifies the tests that were performed and the sequence of that performance. Proof pressure, leakage, functional, flow, and electrical tests were performed whenever specified in the test procedure. All authorized engineering changes had been incorporated in the procedure at the time of testing.

Tests and Test Sequences:

a. Pre-test Inspection
b. Proof Pressure Test
c. Leakage Test
d. Functional Test (including electrical tests)
e. Repeat Cycle Tests
f. Vibration Test
g. Mechanical Shock Test

4.1 Pre-test Inspection

The test specimen was inspected for conformance with applicable vendor drawings and Douglas SCD 1A49965. Part identification, including vendor name, vendor part number, specification control number, change letter and manufacturer's serial number, were recorded. Specimen weight was measured and recorded, and markings indicating "Test" and specimen number were verified. Results of this inspection were recorded on a test data sheet. Upon completion of the pre-test inspection, the two instrumentation ports shown on addendum page C-1, were capped. The caps remained on these ports throughout the test program.

4.2 Proof Pressure Test

(See addendum page C-2.)

4.2.1 Actuator

With the test specimen on the test fixture, P/N 1T03446, both were installed in a burst chamber. The test apparatus was connected to the test specimen as shown schematically on addendum page C-2. The test specimen was stabilized at ambient room temperature and the pressure at the test specimen actuator port was gradually increased to 750 psig with gaseous helium at ambient room temperature. This pressure was maintained for 5 minutes. The test specimen and test medium pressure and temperatures were measured and recorded. System pressure was then decreased to zero psig and the helium vent valve opened. The test specimen was removed from the test apparatus to verify that there was no structural failure or permanent distortion.

4.2.2 Valve Body

With the test specimen mounted on test fixture P/N 1T03446, both were installed in a burst chamber. The test specimen was verified free of moisture by either clean room inspection or GN_2 purge. After connecting the test apparatus to the test specimen as shown schematically on addendum page C-2, the nitrogen vent valve and the LN_2 shutoff valve were opened and liquid nitrogen flowed through the test specimen until the temperature stabilized. The LN_2 shutoff valve was then closed and the drain valve opened. When liquid nitrogen ceased to flow, the drain and vent valves were closed. The GN_2 shutoff valve was then opened and the pressure increased at the test specimen inlet to 190 psig with GN_2 at a temperature of -300 ($\pm$20)^{o}F. This pressure was maintained for 5 minutes. The system pressure was then decreased to zero psig and the nitrogen vent valve opened. During this test, the test specimen and test medium temperatures and pressures were measured and recorded. The test specimen was removed from the test apparatus to verify that there was no structural failure or permanent distortion.

4.3 Leakage Test

4.3.1 External Leakage

(See addendum page C-3.)

The test specimen was mounted on the test fixture, P/N 1T03446, and both were installed in a small sealed chamber. After connecting the test apparatus, using appropriate seals and fittings, to the test specimen inlet port as shown schematically on addendum page C-3, the test specimen was purged with helium gas and then the outlet port capped and sealed. To eliminate the helium background, the chamber was purged with air and then sealed. The chamber was evacuated with the roughing pump until the leak detector could take over and continue evacuating the chamber to the vacuum specified by the manufacturer for best operation. When the background level of helium was established the pressure to the test specimen inlet port was gradually increased to a maximum of 125 psig using gaseous helium at ambient room temperature. The leak detector meter indications were recorded at 25 psig increments. Test specimen and test medium temperatures and pressure were measured and recorded. Upon completion of the test, the leak detector shutoff valve was closed and the chamber pressure gradually increased to ambient room conditions by use of the vacuum release valve. The test apparatus was disconnected from the test specimen and removed from the chamber. Test specimen leakage rates were determined and recorded in scch at each 25 psig increment. External leakage of the test specimen was not to exceed 1 scch.

4.3.2 Internal Leakage

(See addendum page C-4.)

4.3.2.1 Gate Seal

After mounting the test specimen on the test fixture, P/N 1T03446, the test apparatus was connected, using appropriate seals and fittings, to the test specimen as shown schematically on addendum C-4. The leakage shutoff valve was closed and the

4.3.2.1 Gate Seal (Cont'd)

cooling and the LN_2 shutoff valves opened. LN_2 was flowed at 31 gpm through the test specimen until it was temperature stabilized. The pressure of the LN_2 was increased at the test specimen inlet port to 80 (±5) psig. When the test specimen was temperature stabilized, the helium gas pressure was increased at the test specimen actuator port to 475 psig using helium gas at ambient room temperature. This closed the test specimen. Liquid was maintained to the test specimen inlet at 80 (±5) psig. When liquid and/or gas ceased to flow at the cooling valve, the cooling valve was closed and the leakage shutoff valve opened. This inlet pressure was maintained for a period of 5 minutes while the internal leakage rate was determined. Determination of the leakage rate started with the first detected leakage. (i.e., bubbling in graduate). The test specimen and test medium temperature and pressure, the displaced water volume, time interval required to displace water, the gas temperature at the outlet of the heat exchanger, and the water temperature were measured and recorded. The leakage rate was determined in scim. Internal leakage rate was not to exceed 30 scim.

4.3 2.2 Actuator

After the test specimen was mounted on the test fixture, P/N 1T03446. installed in a small sealed chamber, the purged test apparatus was connected, using appropriate seals and fittings, to the test specimen actuator port as shown schematically on addendum page C-5. Test specimen inlet and outlet ports were not capped. The vacuum pump was started and the test apparatus and test specimen actuator evacuated. Vacuum pumping was stopped and the system pressure increased to zero psig using ambient room temperature helium gas. Using a mass spectrometer with a secondary roughing pump, the chamber was evacuated until the leak detector pumping system could take over the chamber evacuation. The leak detector evacuated the chamber to a vacuum specified by the equipment manufacturer for best operation. Then, the

4.3.2.2 Actuator (Cont'd)

helium background level was established and the pressure to the test specimen actuator port was increased to 475 psig using gaseous helium at ambient room temperature. The test specimen and test medium pressure and temperature and the leak detector meter indication were measured and recorded. Internal leakage rate of the test specimen actuator was determined in scch and was not to exceed 1 scch. The leak detector was isolated from the system and the chamber pressure increased to zero psig with the vacuum release valve. Pressure to the test specimen actuator port was reduced to zero psig and the vent valve opened. The test apparatus was then disconnected from the test specimen and the specimen was removed from the chamber.

4.4 Functional Test

(See addendum pages C-6 and C-7.)

4.4.1 Response Time

After mounting the test specimen on the test fixture, P/N 1T03446. the test apparatus was connected using appropriate seals and fittings, to the test specimen as shown schematically on addendum page C-6. Addendum page C-7 is a schematic diagram of the test specimen position indicator and test wire harness. The harness was connected to the test specimen and to a position indicator light panel. When the helium gas regulator was adjusted for a pressure of 475 psig at the test specimen actuator port, the 3-way solenoid valve was closed and the pressure at the actuator port decreased to zero psig. Liquid nitrogen was then flowed through the test specimen until it was temperature stabilized. The liquid flow was gradually increased to 31 gpm. A pressure of 80 psig was not exceeded at the test specimen inlet port. The 3-way solenoid valve was then opened and the test specimen allowed to shut off the flow of LN_2. Pressure at the test specimen inlet, outlet, and actuator ports, the flow

4.4.1 Response Time (Cont'd)

through the test specimen, and the signals from the test specimen position indicator switch were recorded on a recording oscillograph. The test specimen and test medium temperatures were measured and recorded. The response time was determined from the instant of the first trace movement of the "Open" switch to the first trace movement of the "Close" switch. At the conclusion of the test, the LN_2 and helium gas flow were shut off and the specimen allowed to stabilize at ambient room temperature.

4.4.2 Position Indication

While performing the response time test of paragraph 4.4.1, the position indicator light panel was observed to verify the following conditions:

a. The fully "Open" indication was present after temperature stabilization.

b. The fully "Closed" indication was present when the outlet pressure had decreased to zero psig.

c. The fully "Open" indication was present upon venting the actuator port to zero psig.

d. The fully "Open" indication was present after the test specimen has stabilized at ambient room temperature.

4.4.3 Dielectric Strength

With the valve in the full open position, the specimen was stabilized at room ambient temperature. A 1000 vac rms, 60 cps, test voltage was applied for 1 minute between the pins listed below. The test voltage was raised from zero to 1000 volts at a rate not exceeding 250 volts per second for each point as tested. Current leakage was measured and recorded and was not to exceed 200 microamperes.

4.4.3 Dielectric Strength (Cont'd)

From Pin	To Pin
A-B common	C, D, F, G, J, K, M
C	D, F, G, J, K, M
D-E common	F, G, J, K, M
F	G, J, K, M
G-H common	J, K, M
J	K, M
K-L common	M
Ground	A-B common, C D-E common, F G-H common, J K-L common, M

With the valve in the closed position, the specimen was stabilized at room ambient temperature. A 1000 vac rms, 60 cps, test voltage was applied for 1 minute between the pins listed below. The test voltage was raised from zero to 1000 volts at a rate not exceeding 250 volts per second for each point as tested. **Current leakage was measured and recorded and was not to exceed 200 microamperes.**

From Pin	To Pin
A	B, D, E, G, H, K, L
B-C common	D, E, G, H, K, L
D	E, G, H, K, L
E-F common	G, H, K, L
G	H, K, L
H-J common	K, L
K	L-M common
Ground	A, B-C common, D, E-F common G, H-J common, K, L-M common

4.4.4 Insulation Resistance

With the valve in the full open position, the specimen was stabilized at room ambient temperature. The resistance was measured and recorded between the pins listed below with 500 vdc power applied. The resistance was to be 100 megohms or greater.

4.4.4 Insulation Resistance (Cont'd)

From Pin	To Pin
A	B, D, E, G, H, K, L
B-C common	D, E, G, H, K, L
D	E, G, H, K, L
E-F common	G, H, K, L
G	H, K, L
H-J common	K, L
K	L-M common
Ground	A, B-C common, D, E-F common G, H-J common, K, L-M common

4.4.5 Bonding Resistance

With the valve in any position and stabilized at room ambient temperature, the resistance was measured between the ground pin and the valve body. The resistance was not to exceed 0.1 ohm.

4.4.6 Continuity Check (Open Position)

The test wire harness was disconnected from the specimen prior to performing the continuity check. With the valve in the fully open position, the specimen was stabilized at room ambient temperature. Continuity was verified between pins A - B, D - E, G - H, and K - L by measuring the resistance. The values were recorded. In no case was the resistance to exceed 0.25 ohm.

No continuity between pins B - C, E - F, H - J, and L - M was verified by measuring the resistance. The values were recorded. In no case was the resistance to be less than 20 megohms.

4.4.7 Continuity Check (Closed Position)

The wire harness was disconnected from the specimen prior to performing the continuity check. With the valve in the fully closed position, the specimen was stabilized at room ambient temperature. Continuity between pins B - C, E - F, J - H, and L - M was verified by measuring the resistance. The values were recorded. In no case was the resistance to exceed 0.25 ohm.

4.4.7 Continuity Check (Closed Position)(Cont'd)

No continuity between pins A - B, D - E, G - H, and K - L was verified by measuring the resistance. The values were recorded. In no case was the resistance to be less than 20 megohms.

4.5 Repeat Cycle Test

(See addendum page C-6.)

The repeat cycle test consisted of 500 cycles at low temperature, 450 cycles at ambient room temperature, and 50 cycles at high temperature. A low-temperature cycle consisted of closing the test specimen valve against a LN_2 flow of 31 gpm at an inlet pressure not exceeding 80 psig, then opening the test specimen valve. The ambient room temperature and high temperature cycles consisted of closing the test specimen valve against a gaseous nitrogen inlet pressure not exceeding 80 psig, then opening the test specimen valve. Cycling and data requirements were as indicated in paragraph 4.4.1. Allowable gate seal leakage after completion of all cycling tests was not to exceed 100 scim.

4.5.1 General

The test specimen was mounted on test fixture 1T03446 and placed in an environmental chamber capable of maintaining a temperature of $+160^{\circ}F$. The test apparatus was connected to the test specimen as shown schematically on addendum page C-6. The operation of the 3-way solenoid valve to actuate and deactuate the test specimen valve by pressurizing or venting the test specimen actuation port pressure was controlled by the sequencer shown on addendum page C-6. The LN_2 shutoff valve was opened and LN_2 was maintained at the specimen throughout the repeat cycle test by venting the supply line.

4.5.2 Low Temperature Cycling

Using the procedure of paragraph 4.4.1, the specimen was temperature-stabilized with liquid nitrogen flow. Temperature stabilization was required only at the beginning of the cycling. The

4.5.2 Low Temperature Cycling (Cont'd)

sequencer was set to energize and deenergize the 3-way solenoid at a rate not exceeding 2 cycles/minute for a total of 500 cycles. Data specified in paragraph 4.4.1 was recorded every 25 cycles. At the completion of 500 cycles, the sequencer was stopped when the specimen valve was in the open position. Valve V1 and the LN_2 shutoff valve were closed and valve V-2 opened. Using GN_2, all of the LN_2 was purged from the supply line. Valve V-2 was closed, valve V-1 opened, and all of the LN_2 purged from within the test specimen. The flowmeter at the specimen outlet port was removed.

4.5.3 Ambient Room Temperature Cycles

Upon completion of 500 cycles at low temperature and with the specimen stabilized at ambient room temperature, valves V-1 and V-2 were closed and the pressure of the ambient room temperature GN_2 increased to 80 psig. Valve V-1 was opened and the sequencer started. The cycling sequence was as described in paragraph 4.5.2, except that ambient room temperature GN_2 was the test medium, until a total of 450 cycles were completed. The data specified in paragraph 4.4.1 was recorded every 25 cycles. Upon completion of the 450 cycles, the sequencer was stopped when the specimen valve was in the open position.

4.5.4 High Temperature Cycles

Upon completion of 450 cycles at ambient room temperature and with the test specimen stabilized at ambient room temperature, the ambient chamber temperature was increased to +160°F. The temperature was maintained for the duration of the test. The specimen was stabilized at +160°F, then valves V-1 and V-2 closed and the pressure of the +160°F gaseous nitrogen increased to 80 psig. Valve V-1 was opened and the sequencer started. The cycling sequence was as described in paragraph 4.5.2, except that gaseous nitrogen at +160°F was the test medium, until a total of 50 cycles were completed. The data specified in

4.5.4 High Temperature Cycles (Cont'd)

paragraph 4.4.1 was recorded every cycle. Upon completion of 50 cycles at +160°F, valve V-1 was closed and the chamber environment decreased to ambient room conditions allowing the test specimen to stabilize at ambient room temperature. The test apparatus was disconnected from the test specimen and the specimen removed from the environmental chamber.

4.5.5 Post Repeat Cycle Test

Upon completion of the 1000 cycles, the proof pressure, internal leakage, response time, position indication, insulation resistance, and continuity tests of paragraph 4.2, 4.3.2, 4.4.1, 4.4.2, 4.4.4, 4.4.6, and 4.4.7 respectively were performed.

4.6 Vibration Test

4.6.1 General

(See addendum pages C-8 through C-11.)

The test specimen was subjected to the vibration environment in each of three mutually perpendicular axes, using the vibration test setup as shown on addendum pages C-9 and C-10. The test apparatus was connected to the test specimen as shown schematically on addendum page C-8 and the specimen, including the associated mounting clamps, brackets, and supports, was attached to a rigid test fixture, which dynamically simulated the vehicle installation, per vibration test assembly drawing 1T07824.

Vibration test fixture P/N 1T01097 was used. The test specimen was instrumented with six accelerometers, located as shown on addendum page C-8. Vibration amplitude versus frequency and the G^2/cps versus frequency were recorded on recorders from which reproducible copies of the plots could be obtained. Sinusoidal and random vibration tests were performed in one axis before changing the axis of vibration. The specimen axes were defined as follows:

4.6.1 General (Cont'd)

Direction	Description
A	Line of Flight - specimen rotated 16° counterclockwise in plane of inlet axis.
B	Radial Axis - 48° counterclockwise in plane of specimen outlet axis perpendicular to the flight axis.
C	Tangential Axis - normal to the radial axis.

4.6.2 Equalization Control System Checks

4.6.2.1 Sinusoidal Vibration

The control accelerometer (No. 1) signal between 5 and 200 cps on the up and downsweep was filtered utilizing a Spectral Dynamics tracking filter.

One alternate control accelerometer (No. 2) location was designated by the Acoustics and Structural Dynamics (A & SD) engineer. The signal from the alternate control(s) was filtered as above. In addition, the alternate control(s) was monitored during the filtered portion of the sweep and its acceleration level constrained to not exceed the test specification. This was accomplished using manual or automatic override techniques at the control console.

4.6.2.2 Random Vibration

The formal qualification vibration test of the specimen in each axis was conducted only after the data from the equalization control check for the same axis had been reviewed by the Acoustics and Structural Dynamics Section to verify that the proper spectrum had been obtained.

The signal from the control accelerometer was recorded on magnetic tape played back into a mean square acceleration spectral density analyzer (either analog or digital) with a filter having a bandwidth of 20 cps. Data were presented in graphical form showing, G^2/cps versus frequency. The random vibration level

4.6.2.2 Random Vibration(Cont'd)

to be used for equalization was 6 db below the specified test level (quarter-power level).

4.6.3 Operational Test

The operational test was performed while the test specimen was being subjected to the vibration tests. When the test apparatus was connected to the test specimen as shown schematically on addendum page C-8, the LN_2 shutoff valve was opened and LN_2 was flowed through the test specimen until the specimen was temperature stabilized. With the test specimen not actuated, the vent valve was closed and the LN_2 pressure increased to 80 psig. This pressure and temperature were maintained during the test. The test specimen was actuated and deactuated at least once during each axis of applied vibration by applying gaseous helium at ambient room temperature and at a pressure of 475 psig to the test specimen actuator port. Deactuation occurred when the pressure at the actuator port was decreased to zero psig. The test specimen and test media pressures and temperatures and the number of cycles were measured and recorded. Upon completion of vibration in each axis, the LN_2 shutoff valve was closed and the the LN_2 vent valve opened.

4.6.4 Sinusoidal Vibration Test

(See addendum page C-9.)

The test specimen was assembled and installed on the test apparatus and instrumented as shown schematically on addendum page C-9. The operational test of paragraph 4.6.3 was performed while subjecting the test specimen to a sinusoidal logarithmic sweep at a rate of 1.0 octave per minute from 5 to 2000 to 5 cps in each axis at the amplitude shown below:

Frequency (cps)	Amplitude
5 to 24	0.032-inch D.A.
24 to 47	1.0 G peak
47 to 200	0.0088-inch D.A.
200 to 2000	17.5 G peak

4.6.4 Sinusoidal Vibration Test (Cont'd)

All accelerometer outputs were recorded on a direct writing oscillograph. Testing continued directly to the random vibration test in paragraph 4.6.5.

4.6.5 Random Vibration Test

The operational test of paragraph 4.6.3 was performed while subjecting the test specimen to a random vibration environment having an approximate Gaussian amplitude distribution and a peak-to-rms ratio of three. Equalization of the random input spectrum was accomplished by using a random vibration level which was not more than one-fourth of the actual test level. The equalized spectrum was monitored and readjusted during the test as necessary by:

a. Using individual meters on each channel of the spectral density analyzer/equalizer or,

b. Using graphical displays on spectral density analyzers.

The acceleration power spectral density applied to the test specimen was within ±3 db when measured with a filter having a bandwidth of 20 cps.

A 12-minute random vibration was applied over the frequency interval as noted:

Frequency (cps)	Amplitude
20 to 60	0.01 G^2/cps
60 to 120	+10 db/octave
120 to 2000	0.1 G^2/cps

The power spectral density was recorded as a function of G^2/cps. Testing continued directly to the shock test in paragraph 4.7.

4.7 Mechanical Shock Test

(See addendum pages C-7 through C-10 and C-12.)

The test specimen was subjected to three shocks in one direction in each of three mutually perpendicular axes for a total of nine shocks. The test specimen, including the associated mounting

4.7 Mechanical Shock Test (Cont'd)

clamps, brackets, supports, and test apparatus, was attached to a rigid test fixture, P/N 1T01097, which dynamically simulated the vehicle installation, and instrumented as shown schematically on addendum pages C-7. C-8, and C-10 with six accelerometers. All accelerometer signals were recorded on an oscillograph while the oscilloscope presentation of the shock input transients was recorded photographically. The shocks were performed on a L-249 vibration exciter. The test sequence was sinusoidal vibration, random vibration, and shock prior to changing axis.

4.7.1 Shock Test Levels and Axes

The shock level for all three axes was 20 G's peak amplitude of a half sine pulse for a duration of 10 (±2) milliseconds. Shocks were applied in either direction along the A, B, and C axes. The test specimen was to withstand the nine shocks without failure. Integrity of the test specimen was verified by performing an inspection after completion of the shock test. The sinusoidal, random, and shock tests were repeated for the remaining axes.

4.7.2 Post Vibration and Shock Test

The proof pressure and leakage tests of paragraphs 4.2 and 4.3 were performed after completion of all shock and vibration tests.

5.0 TEST RESULTS AND DISCUSSION

5.1 Pre-test Inspection

Pre-test inspection was performed October 12, 1966. The test specimen was free of apparent defects, was properly identified and, therefore, considered acceptable for testing. Results of this inspection are presented on addendum page A-1.

5.2 Proof Pressure Test

Actuator and valve body proof pressure tests were performed three times (pre-functional, post repeat cycle, and post vibration) during the test program as required. There was no evidence of structural failure or permanent distortion as a result of these pressurizations. Results of these tests are presented on addendum pages A-2, A-39, and A-84.

5.3 Leakage Test

External and internal leakage tests were performed as required. External leakage was negligible. Internal leakage was well below the maximum allowable rate of 1 scch except during the post vibration leakage check where a leakage rate of 32,570 scch was recorded. Results of these tests are presented on addendum pages A-3, A-4, A-40, and A-85 through A-87.

5.4 Functional Test

Functional tests were performed (omitting dielectric strength) to check valve response time and electrical characteristics. Results of these tests are presented on addendum pages A-5 through A-7 and A-41 through A-43. Valve actuation closing time varied from 0.050 second to 0.054 second (no limit was specified). Valve actuation opening time was 0.210 second (no limit was specified).

While performing valve response tests, the valve position indicator lights were checked for proper indication of valve position. In every case the lights indicated that the valve had assumed the

5.4 Functional Test (Cont'd)

proper position dependent upon the test conditions imposed.

Complete or partial electrical tests were performed during the test program. The results of these tests are presented on addendum pages A-6, A-7, and A-42 and A-43. The dielectric strength test was performed only once in order to avoid possible damage to the electrical insulation. The electrical characteristics (dielectric strength, insulation resistance, bonding, resistance, and continuity) are all within the limits specified.

5.5 Repeat Cycle Test

Ambient, high, and low temperature repeat cycle tests were performed. These cycles were followed by proof pressure, internal leakage, response time, position indication, insulation resistance, and continuity tests. The results of this testing are presented on addendum pages A-8 through A-38.

Valve response time varied as follows:

Ambient temperature	-	Closing time 0.015 to 0.019 second Opening time 0.192 to 0.220 second
High temperature	-	Closing time 0.015 to 0.017 second Opening time 0.098 to 0.108 second
Low temperature	-	Closing time 0.010 to 0.057 second Opening time 0.106 to 0.297 second

All post repeat cycle tests were within the specification limits. These data are presented on addendum pages A-39 through A-43.

5.6 Vibration and Mechanical Shock Tests

Sinusoidal vibration, random vibration, and mechanical shock tests were performed on the test specimen in the following sequence:thrust (A), radial (B), and tangential (C). The testing was completed in each axis prior to changing the setup for the next axis.

5.6 Vibration and Mechanical Shock Tests (Cont'd)

All vibration test setups and acceleration levels were approved by the Acoustics and Structural Dynamics Representative.

Thrust axis sinusoidal vibration control accelerometers (upscale, downscale, filtered, and unfiltered) data are presented on addendum pages A-44 and A-46 through A-51. All control accelerometer data are within or above specification. Thrust axis random vibration levels are within or above the 3 db specification level as shown on addendum pages A-45 and A-52 through A-56.

Thrust axis shock pulse data are presented on addendum pages A-45 and A-57. These shock pulses were obtained utilizing an L-249 vibration exciter (typical for all shock test's) and are within the 20 ±3-G level and 10 ±2 milliseconds time duration of the specification.

Radial axis sinusoidal vibration control accelerometers data are presented on addendum pages A-58 and A-60 through A-65. Testing was stopped at 1000 cps on the upsweep to change the control and alternate accelerometers (number 1 and 2). These accelerometers were changed due to poor response at low temperatures. Examination of the upsweep test data indicated the test levels were 70 to 100% over specification levels from 100 to 1000 cps. Since internal leakage tests were required only at the conclusion of all vibration and shock testing no specimen damage due to overtest was indicated at this time. Therefore, after changing the control and alternate accelerometers testing continued to the conclusion of all vibration and mechanical shock. Radial axis random vibration data are presented on addendum pages A-59 and A-66 through A-68 and are within or above the 3 db specification level.

Radial axis shock pulse data are presented on addendum pages A-59 and A-69.

5.6 Vibration and Mechanical Shock Tests (Cont'd)

Tangential axis sinusoidal vibration accelerometer data are presented on addendum pages A-70 and A-72 through A-77. All control accelerometer levels are within or above the specified limits over the entire frequency range.

Tangential axis random vibration data are presented on addendum pages A-71, A-78 through A-81, and A-83 and are within or above the 3 db specification level.

Tangential axis shock pulse traces are presented on Addendum page A-82. There was no apparent damage to the specimen.

Vibration data for the response accelerometers are not included in this report; however, unreduced data have been filed and are available upon request.

Post vibration and shock proof-pressure and external leakage tests were satisfactorily accomplished. Results are presented on Addendum A-84 and A-85.

6.0 CONCLUSION

Because the post vibration and shock internal leakage was 32,570 scch (as indicated in Addendum A-86 and A-87), with the specification maximum being 1 scch, testing was discontinued and the specimen returned to the Douglas Santa Monica Facility for failure analysis. The failure was attributed to the over testing during the radial axis sinusoidal vibration from 100 to 1000 cps of the upsweep (see D-1 through D-16).

7.0 REFERENCES

1A49965, Revision Y, Douglas Specification Control Drawing
1T07782, Revision C, Douglas Test Requirements Drawing
1T07783, Revision D, Douglas Test Procedure
1T03446, Douglas Test Fixture
SM-41412, Douglas Saturn General Test Plan
SM-46532, Douglas Formal Qualification Test Program

ATTACHMENTS:

Pages A-1 through A-78
Pages B-1 through B-2
Pages C-1 through C-12
Pages D-1 through D-16
Pages E-1 through E-5

ADDENDUM A

TEST DATA SHEETS

FORMAL QUALIFICATION TEST DATA SHEET

Item Name: LO_2 Chilldown System Shutoff Valve

Part Number: 1A49965-521

Test Procedure Drawing No: 1T07783 Change Letter: C

Manufacturer's S/N: 0201 Test Plan Line Item: FQ-F-14A

Test Laboratory: BEECH AIRCRAFT Location: BOULDER, COLORADO

Douglas Test Representative: K.C. TOLIDES Date: 10-12-66

Test Witness: _____ Douglas Q.C. _____ Customer Q.C.

Pre-Test Inspection Per Paragraph: 5.8

Test Specimen No: 1

Test Start (Date, Time): 10-12-66, 1500

Test Completed (Date, Time): 10-12-66, 1530

Vendor Name: FAIRCHILD-HILLER Vendor P/N: 64-401-05

Vendor Drawing No: 64-401-05

Conforms to Vendor Drawing: 64-401

Specification Control No: 1A49965-521 Change Letter: _____

Conforms to Specification Control Drawing: _____

Test Specimen Weight: 2908 GRAMS = 6 Lbs., 6.6 oz.

Accept: X Reject: _____

Comments: _____

FORMAL QUALIFICATION TEST DATA SHEET

Item Name: LO_2 Chilldown System Shutoff Valve

Part Number: LA49965-521

Test Procedure Drawing No: 1T07783 Change Letter: C

Manufacturer's S/N: 0201 Test Plan Line Item: FQ-F-14A

Test Laboratory: BEECH AIRCRAFT Location: BOULDER, COLORADO

Douglas Test Representative: V.C. TOLIDES Date: 10-15-66

Test Witness: _____ Douglas Q.C. _____ Customer Q.C.

Proof Pressure Test Per Paragraph: 5.9

Test Specimen No: 1

Test Start (Date, Time): 10-15-66, 2350

Test Completed (Date, Time): 10-17-66, 1140

Ambient Room Conditions:	Temperature °F	RH %	Atm. Press. In. Hg abs.
	68	40	624.5 mm

Valve Body

Test Parameter	Unit	Required	Actual
Temperature	°F	-300 (±20)	-310
Pressure	psig	190	190
Time	minutes	5	5

Actuator

Test Parameter	Units	Required	Actual
Temperature	°F	Ambient	67
Pressure	psig	750	750
Time	minutes	5	5

Accept: X Reject: _____

Comments: _____

FORMAL QUALIFICATION TEST DATA SHEET

Item Name: LO_2 Chilldown System Shutoff Valve

Part Number: 1A49965-521

Test Procedure Drawing No: 1T07783 Change Letter: C

Manufacturer's S/N: 0201 Test Plan Line Item: FQ-F-14A

Test Laboratory: BEECH AIRCRAFT Location: BOULDER, COLO.

Douglas Test Representative: K. G. TOLIDES Date: 10-18-66

Test Witness: [signature] Douglas Q. C. Customer Q. C

External Leakage Test Per Paragraph: 5.10.1

Test Specimen No: 1

Test Start (Date, Time): 10-18-66, 1315

Test Completed (Date, Time): 10-18-66, 1436

Ambient Room Conditions:

Temperature °F	RH %	Atm. Press. In. Hg abs.
62	40	626 mm

External Leakage

Test Parameter	Units	Required	Actual
Specimen Temperature	°F	Stabilized	39
Leakage Rate	scch	1.0	4×10^{-9}
Inlet Pressure	psig	125 Maximum	125
Time Maintained	Minutes	5	5

Accept: X Reject:

Comment:

FORMAL QUALIFICATION TEST DATA SHEET

Item Name: LO_2 Chilldown System Shutoff Valve

Part Number: 1A49965-521

Test Procedure Drawing No: 1T07783 Change Letter: C

Manufacturer's S/N: 0201 Test Plan Line Item: FQ-F-14A

Test Laboratory: BEECH AIRCRAFT Location: BOULDER, COLO.

Douglas Test Representative: K. C. TOLIDES Date: 10-18-66

Test Witness: K. H. Pratt (Douglas Q. C.) (Customer Q. C.)

Internal Leakage Test Per Paragraph: 5.10.2

Test Specimen No: 1

Test Start (Date, Time): 10-18-66, 2300

Test Completed (Date, Time): 10-19-66, 1135

Ambient Room Conditions:	Temperature °F	RH %	Atm. Press. In. Hg abs.
	51	42	626 mm

Gate Seal

Test Parameter	Units	Required	Actual
Specimen Temperature	°F	Stabilized	-300
Inlet Pressure	psig	80 Maximum	78
Actuator Port Pressure	psig	475	475
Leakage Rate	scim	30	1.9
Time Maintained	minutes	5	5

Actuator

Test Parameter	Units	Required	Actual
Actuator Port Pressure	psig	475	475
Specimen Temperature	°F	Ambient	56
Leakage Rate	scch	1.0	3.5×10^{-3}
Maintained	minutes	5	5

FORMAL QUALIFICATION TEST DATA SHEET

Item Name: LO_2 Chilldown System Shutoff Valve

Part Number: LA49965-521

Test Procedure Drawing No: LT07783 Change Letter: C

Manufacturer's S/N: 0201 Test Plan Line Item: FQ-F-14A

Test Laboratory: BEECH AIRCRAFT Location: BOULDER, COLORADO

Douglas Test Representative: K. C. TOLIDES Date: 10-19-66

Test Witness: _____ Douglas Q.C. _____ Customer Q.C.

Functional Test Per Paragraph: 5.11

Test Specimen No: 1

Test Start (Date, Time): 10-19-66, 1728

Test Completed (Date, Time): 10-20-66, 0700

Ambient Room Conditions:	Temperature °F	RH %	Atm. Press. In. Hg abs.
	69	32	621.5 mm

Response Time

Test Parameter	Units	Required	Actual
Specimen Temperature	°F	Stabilized	-293
Pressure (Inlet)	psig	80 max.	60
Flow	gpm	31 max.	N/A
Pressure (Actuator)	psig	475	475
Response Time	sec.	Closing	0.054
		Opening	0.210

Paper Speed 25 in/sec.

Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch

Time Base 500 cycles/seconds

Accept: X Reject: _____

Comment: _____

FORMAL QUALIFICATION TEST DATA SHEET

Functional Test Per Paragraph: _____ Test Plan Line Item: FQ-F-14A

Position Indicator

A. Temperature Stabilized _____ OPEN Indicator Light ON _____

B. Outlet Pressure Zero _____ CLOSED Indicator Light ON _____

C. Actuator Pressure Zero _____ OPEN Indicator Light ON _____

D. Temperature at Ambient _____ OPEN Indicator Light ON _____

Accept: X Reject: _____

Comment: _____

Dielectric Strength

Test Parameter	Units	Required	Actual
Voltage	vac rms	1000	
Frequency	cps	60	
Rate of Application	volts/sec.	250 maximum	
Time	minutes	1	
Leakage Current	microamperes	200	

Accept: X Reject: _____

Comments: _____

Insulation Resistance

Test Parameter	Units	Required	Actual
Voltage	vdc	500	
Insulation Resistance	megohms	100 minimum	20K

Accept: X Reject: _____

Comments: K meg

Bonding Resistance

Test Parameter	Units	Required	Actual
Resistance	ohms	0.1 maximum	

Accept: X Reject: _____

Comments: _____

FORMAL QUALIFICATION TEST DATA SHEET

Functional Test Per Paragraph: _____ Test Plan Line Item: FQ-F-14A

Continuity Check (Open Position)

Test Parameter	Units	Required	Actual			
Continuity	ohms	0.25 maximum	A-B	D-E	G-H	K-L
			.[illegible]	.041	.043	.040
No Continuity	megohms	20 minimum	B-C	E-F	H-J	L-M
			See [illegible]			

Accept: X Reject: _____

Comment: [illegible]

Continuity Check (Closed Position)

Test Position	Units	Required	Actual			
Continuity	ohms	0.25 maximum	B-C	E-F	J-H	L-M
			See [illegible]			
No Continuity	megohms	20 minimum	A-B	D-E	G-H	K-L
			[illegible]			

Accept: X Reject: _____

Comment: [illegible]

FORMAL QUALIFICATION TEST DATA SHEET

Item Name: LO_2 Chilldown System Shutoff Valve

Part Number: 1A49965-521

Test Procedure Drawing No: 1T07783 Change Letter: C

Manufacturer's S/N: 0201 Test Plan Line Item: FQ-F-14A

Test Laboratory: BEECH AIRCRAFT Location: BOULDER, COLORADO

Douglas Test Representative: K.C. TOLIDES Date: 10-20-66

Test Witness: _____ Douglas Q.C. _____ Customer Q.C.

Repeat Cycle Test Per Paragraph: 5.19

Test Specimen No: 1

Test Start (Date, Time): 10-20-66, 1105

Test Completed (Date, Time): 10-21-66, 740

Ambient Room Conditions	Temperature °F	RH %	Atm. Press. In. Hg abs.
	67	32	616 mm

Low Pressure Opening:

Test Parameter	Units	Required	Actual
Specimen Temperature	°F	stabilized	-255
Inlet Pressure	psig	80 maximum	66
Flow (LO_2)	gpm	31 maximum	N/A
Actuator Pressure	psig	475	470
Response Time	sec.	Closing	0.056
		Opening	0.188

Paper Speed 2 in./sec.

Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch

Time Base 500 cycles/ seconds

FORMAL QUALIFICATION TEST DATA SHEET

Repeat Cycle Test per Paragraph: 5.19 Test Plan Line Item: FQ-F-14A

50 Cycles

Test Parameter	Units	Required	Actual
Specimen Temperature	°F	stabilized	-230
Inlet Pressure	psig	80 maximum	39
Flow (LN_2)	gpm	31 maximum	N/A
Actuator Pressure	psig	475	475
Response Time	sec.	Closing	0.044
		Opening	0.210

Paper Speed 25 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles / seconds

75 Cycles

Test Parameter	Units	Required	Actual
Specimen Temperature	°F	stabilized	-230
Inlet Pressure	psig	80 maximum	59
Flow (LN_2)	gpm	31 maximum	N/A
Actuator Pressure	psig	475	470
Response Time	sec.	Closing	0.054
		Opening	0.174

Paper Speed 25 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles / seconds

100 Cycles

Test Parameter	Units	Required	Actual
Specimen Temperature	°F	stabilized	-235
Inlet Pressure	psig	80 maximum	56
Flow (LN_2)	gpm	31 maximum	N/A
Actuator Pressure	psig	475	470
Response Time	sec	Closing	0.052
		Opening	0.206

Paper Speed 25 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles / seconds

FORMAL QUALIFICATION TEST DATA SHEET

Repeat Cycle Test Per Paragraph: 5.19 Test Plan LineItem: FQ-F-14A

125 Cycles

Test Parameter	Units	Required	Actual
Specimen Temperature	°F	Stabilized	-240
Inlet Pressure	psig	80 maximum	38
Flow (LN_2)	gpm	31 maximum	N/A
Actuator Pressure	psig	475	470
Response Time	sec.	Closing	0.054
		Opening	0.232

Paper Speed 25 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles / seconds

150 Cycles

Test Parameter	Units	Required	Actual
Specimen Temperature	°F	stabilized	-240
Inlet Pressure	psig	80 maximum	32
Flow (LN_2)	gpm	31 maximum	N/A
Actuator Pressure	psig	475	470
Response Time	sec.	Closing	0.047
		Opening	0.234

Paper Speed 25 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles / seconds

175 Cycles

Test Parameter	Units	Required	Actual
Specimen Temperature	°F	stabilized	-240
Inlet Pressure	psig	80 maximum	30
Flow (LN_2)	gpm	31 maximum	N/A
Actuator Pressure	psig	475	475
Response Time	sec.	Closing	0.049
		Opening	0.238

Paper Speed 25 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles / seconds

FORMAL QUALIFICATION TEST DATA SHEET

Repeat Cycle Test Per Paragraph: 5.19 Test Plan Line Item: FQ-F-14A

200 Cycles

Test Parameter	Units	Required	Actual
Specimen Temperature	°F	stabilized	-246
Inlet Pressure	psig	80 maximum	42
Flow (LN_2)	gpm	31 maximum	N/A
Actuator Pressure	psig	475	475
Response Time	sec.	Closing	0.052
		Opening	0.208

Paper Speed 25 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles / seconds

225 Cycles

Test Parameter	Units	Required	Actual
Specimen Temperature	°F	stabilized	-245
Inlet Pressure	psig	80 maximum	32
Flow (LN_2)	gpm	31 maximum	N/A
Actuator Pressure	psig	475	475
Response Time	sec.	Closing	0.048
		Opening	0.297

Paper Speed 25 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles / seconds

250 Cycles

Test Parameter	Units	Required	Actual
Specimen Temperature	°F	stabilized	-244
Inlet Pressure	psig	80 maximum	22
Flow (LN_2)	gpm	31 maximum	N/A
Actuator Pressure	psig	475	475
Response Time	sec.	Closing	0.048
		Opening	0.194

Paper Speed 25 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles / seconds

FORMAL QUALIFICATION TEST DATA SHEET

Repeat Cycle Test Per Paragrarh: 5.19 Test Plan Line Item: FQ-F-14A

275 Cycles

Test Parameter	Units	Required	Actual
Specimen Temperature	°F	stabilized	-246
Inlet Pressure	psig	80 maximum	33
Flow (LN_2)	gpm	31 maximum	N/A
Actuator Pressure	psig	475	465
Response Time	sec.	Closing	0.044
		Opening	0.236

Paper Speed 25 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles / seconds

300 Cycles

Test Parameter	Units	Required	Actual
Specimen Temperature	°F	stabilized	-246
Inlet Pressure	psig	80 maximum	28
Flow (LN_2)	gpm	31 maximum	N/A
Actuator Pressure	psig	475	470
Response Time	sec.	Closing	0.037
		Opening	0.230

Paper Speed 25 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles / seconds

Test Parameter	Units	Required	Actual
Specimen Temperature	°F	stabilized	-245
Inlet Pressure	psig	80 maximum	28
Flow (LN_2)	gpm	31 maximum	N/A
Actuator Pressure	psig	475	425
Response Time	sec.	Closing	0.050
		Opening	0.250

Paper Speed 25 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles / seconds

FORMAL QUALIFICATION TEST DATA SHEET

Repeat Cycle Test Per Paragraph: 5.19 Test Plan Line Item: FQ-F-14A

350 Cycles

Test Parameter	Units	Required	Actual
Specimen Temperature	°F	stabilized	-247
Inlet Pressure	psig	80 maximum	27
Flow (LN_2)	gpm	31 maximum	N/A
Actuator Pressure	psig	475	420
Response Time	sec.	Closing	0.050
		Opening	0.125

Paper Speed 2 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles/seconds

375 Cycles

Test Parameter	Units	Required	Actual
Specimen Temperature	°F	stabilized	-247
Inlet Pressure	psig	80 maximum	NOT RECORDED
Flow (LN_2)	gpm	31 maximum	N/A
[illegible]	[illegible]	475	NOT RECORDED
[illegible]	sec.	--	NOT RECORDED

[illegible] HUNG UP [illegible] Flow [illegible] N/A gpm/inch

[illegible] NOT RECORDED [illegible] Time [illegible] NOT RECORDED seconds

[illegible]

[illegible]	Units	Required	Actual
[illegible]	°F	stabilized	-247
[illegible]	psig	80 maximum	32
Flow (LN_2)	gpm	31 maximum	N/A
Actuator [illegible]	psig	475	420
[illegible]	sec.	Closing	0.010
		Opening	0.106

[illegible] 5 in/sec. Flow [illegible] N/A gpm/inch

[illegible] 20 psig/inch Time Base 500 cycles seconds

FORMAL QUALIFICATION TEST DATA SHEET

Repeat Cycle Test Per Paragraph: 5.19 Test Plan Line Item FQ-F-14A

425 Cycles

Test Parameter	Units	Required	Actual
Specimen Temperature	°F	stabilized	-247
Inlet Pressure	psig	80 maximum	80
Flow (LN_2)	gpm	31 maximum	N/A
Actuator Pressure	psig	475	425
Response Time	sec.	Closing	0.057
		Opening	0.200

Paper Speed 25 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch. Time Base 500 cycles / seconds

450 Cycles

Test Parameter	Units	Required	Actual
Specimen Temperature	°F	stabilized	-232
Inlet Pressure	psig	80 maximum	37
Flow (LN_2)	gpm	31 maximum	N/A
Actuator Pressure	psig	475	460
Response Time	sec.	Closing	0.050
		Opening	0.250

Paper Speed 25 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles / seconds

475 Cycles

Test Parameter	Units	Required	Actual
Specimen Temperature	°F	stabilized	-232
Inlet Pressure	psig	80 maximum	32
Flow (LN_2)	gpm	31 maximum	N/A
Actuator Pressure	psig	475	465
Response Time	sec.	Closing	0.049
		Opening	0.250

Paper Speed 25 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles / seconds

FORMAL QUALIFICATION TEST DATA SHEET

Repeat Cycle Test Per Paragraph: 5.19 Test Plan Line Item: FQ-F-14A

500 Cycles

Test Parameter	Units	Required	Actual
Specimen Temperature	°F	stabilized	-232
Inlet Pressure	psig	80 maximum	31
Flow (LH2)	gpm	31 maximum	N/A
Actuator Pressure	psig	475	465
Response Time	sec.	Closing	0.048
		Opening → N/A	0.230

Paper Speed 25 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles/seconds

Accept: X Reject:

Comment:

FORMAL QUALIFICATION TEST DATA SHEET

Repeat Cycle Test per paragraph: 5.19 Test Plan Line Item: FQ-F-14A

25 Cycles

Test Parameter	Units	Required	Actual
Specimen Temperature	°F	stabilized	57
Test Medium Temperature	°F	ambient	71
Inlet Pressure	psig	80 maximum	67
Flow (GN2)	gpm	31 maximum	N/A
Actuator Pressure	psig	475	465
Response Time	sec.	Closing	0.017
		Opening	0.220

Paper Speed 25 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles / seconds

50 Cycles

Test Parameter	Units	Required	Actual
Specimen Temperature	°F	stabilized	57
Test Medium Temperature	°F	ambient	71
Inlet Pressure	psig	80 maximum	65
Flow (GN2)	gpm	31 maximum	N/A
Actuator Pressure	psig	475	465
Response Time	sec.	Closing	0.017
		Opening	0.196

Paper Speed 25 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles / seconds

75 Cycles

Test Parameter	Units	Required	Actual
Specimen Temperature	°F	stabilized	59
Test Medium Temperature	°F	ambient	72
Inlet Pressure	psig	80 maximum	66
Flow (GN2)	gpm	31 maximum	N/A
Actuator Pressure	psig	475	465
Response Time	sec.	Closing	0.018
		Opening	0.200

Paper Speed 25 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles / seconds

FORMAL QUALIFICATION TEST DATA SHEET

Repeat Cycle Test per paragraph: 5.19 Test Plan Line Item: FQ-F-14A

100 Cycles

Test Parameter	Units	Required	Actual
Specimen Temperature	°F	stabilized	59
Test Medium Temperature	°F	ambient	72
Inlet Pressure	psig	80 maximum	65
Flow (GN2)	gpm	31 maximum	N/A
Actuator Pressure	psig	475	465
Response Time	sec.	Closing	0.019
		Opening	NOT RECORDED

Paper Speed 25 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles / seconds

125 Cycles

Test Parameter	Units	Required	Actual
Specimen Temperature	°F	stabilized	59
Test Medium Temperature	°F	ambient	72
Inlet Pressure	psig	80 maximum	65
Flow (GN2)	gpm	31 maximum	N/A
Actuator Pressure	psig	475	465
Response Time	sec.	Closing	0.018
		Opening	0.198

Paper Speed 25 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles / seconds

150 Cycles

Test Parameter	Units	Required	Actual
Specimen Temperature	°F	stabilized	59
Test Medium Temperature	°F	ambient	73
Inlet Pressure	psig	80 maximum	66
Flow (GN2)	gpm	31 maximum	N/A
Actuator Pressure	psig	475	465
Response Time	sec.	Closing	0.016
		Opening	0.200

Paper Speed 25 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles / seconds

FORMAL QUALIFICATION TEST DATA SHEET

Repeat Cycle Test per paragraph: 5.19 Test Plan Line Item: FQ-F-14A

175 Cycles

Test Parameter	Units	Required	Actual
Specimen Temperature	°F	stabilized	60
Test Medium Temperature	°F	ambient	74
Inlet Pressure	psig	80 maximum	65
Flow (GPM)	gpm	31 maximum	N/A
Actuator Pressure	psig	475	470
Response Time	sec.	Closing	0.015
		Opening	0.200

Paper Speed 25 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles / seconds

200 Cycles

Test Parameter	Units	Required	Actual
Specimen Temperature	°F	stabilized	61
Test Medium Temperature	°F	ambient	74
Inlet Pressure	psig	80 maximum	65
Flow (GPM)	gpm	31 maximum	N/A
Actuator Pressure	psig	475	465
Response Time	sec.	Closing	0.018
		Opening	0.196

Paper Speed 25 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles / seconds

225 Cycles

Test Parameter	Units	Required	Actual
Specimen Temperature	°F	stabilized	61
Test Medium Temperature	°F	ambient	74
Inlet Pressure	psig	80 maximum	65
Flow (GPM)	gpm	31 maximum	N/A
Actuator Pressure	psig	475	465
Response Time	sec.	Closing	0.018
		Opening	0.202

Paper Speed 25 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles / seconds

FORMAL QUALIFICATION TEST DATA SHEET

Repeat Cycle Test per paragraph: 5.19 Test Plan Line Item: FQ-F-14A

250 Cycles

Test Parameter	Units	Required	Actual
Specimen Temperature	°F	stabilized	61
Test Medium Temperature	°F	ambient	74
Inlet Pressure	psig	80 maximum	64
Flow (GH2)	gpm	31 maximum	N/A
Actuator Pressure	psig	475	465
Response Time	sec.	Closing	0.018
		Opening	0.200

Paper Speed 25 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles / seconds

275 Cycles

Test Parameter	Units	Required	Actual
Specimen Temperature	°F	stabilized	62
Test Medium Temperature	°F	ambient	74
Inlet Pressure	psig	80 maximum	69
Flow (GH2)	gpm	31 maximum	N/A
Actuator Pressure	psig	475	465
Response Time	sec.	Closing	0.017
		Opening	0.196

Paper Speed 25 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles / seconds

300 Cycles

Test Parameter	Units	Required	Actual
Specimen Temperature	°F	stabilized	62
Test Medium Temperature	°F	ambient	74
Inlet Pressure	psig	80 maximum	63
Flow (GH2)	gpm	31 maximum	N/A
Actuator Pressure	psig	475	465
Response Time	sec.	Closing	0.018
		Opening	0.196

Paper Speed 25 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles / seconds

FORMAL QUALIFICATION TEST DATA SHEET

Repeat Cycle Test per paragraph: 5.19 Test Plan Line Item: FQ-F-14A

325 Cycles

Test Parameter	Units	Required	Actual
Specimen Temperature	°F	stabilized	63
Test Medium Temperature	°F	ambient	74
Inlet Pressure	psig	80 maximum	64
Flow (GPM)	gpm	31 maximum	N/A
Actuator Pressure	psig	475	465
Response Time	sec.	Closing	0.018
		Opening	0.202

Paper Speed 25 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles / seconds

350 Cycles

Test Parameter	Units	Required	Actual
Specimen Temperature	°F	stabilized	62
Test Medium Temperature	°F	ambient	74
Inlet Pressure	psig	80 maximum	64
Flow (GPM)	gpm	31 maximum	N/A
Actuator Pressure	psig	475	465
Response Time	sec.	Closing	0.016
		Opening	0.200

Paper Speed 25 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles / seconds

375 Cycles

Test Parameter	Units	Required	Actual
Specimen Temperature	°F	stabilized	62
Test Medium Temperature	°F	ambient	75
Inlet Pressure	psig	80 maximum	63
Flow (GPM)	gpm	31 maximum	N/A
Actuator Pressure	psig	475	465
Response Time	sec.	Closing	0.018
		Opening	0.197

Paper Speed 25 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles / seconds

FORMAL QUALIFICATION TEST DATA SHEET

Repeat Cycle Test per paragraph: 5.19 Test Plan Line Item: FQ-F-14A

400 Cycles

Test Parameter	Units	Required	Actual
Specimen Temperature	°F	stabilized	63
Test Medium Temperature	°F	ambient	75
Inlet Pressure	psig	80 maximum	63
Flow (GN2)	gpm	31 maximum	N/A
Actuator Pressure	psig	475	465
Response Time	sec.	Closing	0.019
		Opening	0.200

Paper Speed 25 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles / seconds

425 Cycles

Test Parameter	Units	Required	Actual
Specimen Temperature	°F	stabilized	65
Test Medium Temperature	°F	ambient	75
Inlet Pressure	psig	80 maximum	63
Flow (GN2)	gpm	31 maximum	N/A
Actuator Pressure	psig	475	462
Response Time	sec.	Closing	0.019
		Opening	0.192

Paper Speed 25 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles / seconds

450 Cycles

Test Parameter	Units	Required	Actual
Specimen Temperature	°F	stabilized	66
Test Media Temperature	°F	ambient	75
Inlet Pressure	psig	80 maximum	63
Flow (GN2)	gpm	31 maximum	N/A
Actuator Pressure	psig	475	460
Response Time	sec.	Closing	0.018
		Opening	0.200

Paper Speed 25 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles / seconds

High Temperature Cycles:

FORMAL QUALIFICATION TEST DATA SHEET

Repeat Cycle Test per paragraph: 5.19 Test Plan Line Item: FQ-E-14A

1 Cycle

Test Parameter	Units	Required	Actual
Chamber Temperature	°F	+160	160
Specimen Temperature	°F	+160	155
Inlet Pressure	psig	80 maximum	62
Flow (GN_2)	gpm	31 maximum at 160°F	N/A
Actuator Pressure	psig	475	380
Response Time	sec.	Closing	0.017
		Opening	0.108

Paper Speed 2 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles / seconds

2 Cycles

Test Parameter	Units	Required	Actual
Chamber Temperature	°F	+160	160
Specimen Temperature	°F	+160	159
Inlet Pressure	psig	80 maximum	74
Flow (GN_2)	gpm	31 maximum at 160°F	N/A
Actuator Pressure	psig	475	420
Response Time	sec.	Closing	0.017
		Opening	0.108

Paper Speed 2 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles / seconds

3 Cycles

Test Parameter	Units	Required	Actual
Chamber Temperature	°F	+160	160
Specimen Temperature	°F	+160	157
Inlet Pressure	psig	80 maximum	61
Flow (GN_2)	gpm	31 maximum at 160°F	N/A
Actuator Pressure	psig	475	450
Response Time	sec.	Closing	0.017
		Opening	0.108

Paper Speed 2 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles / seconds

FORMAL QUALIFICATION TEST DATA SHEET

Repeat Cycle Test Per Paragraph: 5.19 Test Plan Line Item: FQ-F-14A

4 Cycles

Test Parameter	Units	Required	Actual
Chamber Temperature	°F	+160	160
Specimen Temperature	°F	+160	156
Inlet Pressure	psig	80 maximum	61
Flow (GN_2)	gpm	31 maximun at 160°F	N/A
Actuator Pressure	psig	475	350
Response Time	sec.	Closing	0.017
		Opening	0.108

Paper Speed 2 in/sec. Flow Scale 3 N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles/ seconds

5 Cycles

Test Parameter	Units	Required	Actual
Chamber Temperature	°F	+160	160
Specimen Temperature	°F	+160	156
Inlet Pressure	psig	80 maximum	59
Flow (GN_2)	gpm	31 maximum at 160°F	N/A
Actuator Pressure	psig	475	400
Response Time	sec.	Closing	0.017
		Opening	0.108

Paper Speed 2 in/sec. Flow Scale 3 N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles/ seconds

6 Cycles

Test Parameter	Units	Required	Actual
Chamber Temperature	°F	+160	160
Specimen Temperature	°F	+160	156
Inlet Pressure	psig	80 maximum	57
Flow (GN_2)	gpm	21 maximum at 160°F	N/A
Actuator Pressure	psig	475	473
Response Time	sec.	Closing	0.017
		Opening	0.108

Paper Speed 2 in/sec. Flow Scale 3 N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles/ seconds

FORMAL QUALIFICATION TEST DATA SHEET

Repeat Cycle Test Per Paragraph: 5.19 Test Plan Line Item: FQ-F-14A

7 Cycles

Test Parameter	Units	Required	Actual
Chamber Temperature	°F	+160	160
Specimen Temperature	°F	+160	156
Inlet Pressure	psig	80 maximum	57
Flow (GN_2)	gpm	31 maximum at 160°F	N/A
Actuator Pressure	psig	475	473
Response Time	sec.	Closing / Opening	0.017 / 0.108

Paper Speed 2 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles/ seconds

8 Cycles

Test Parameter	Units	Required	Actual
Chamber Temperature	°F	+160	160
Specimen Temperature	°F	+160	157
Inlet Pressure	psig	80 maximum	57
Flow (GN_2)	gpm	31 maximum at 160°F	N/A
Actuator Pressure	psig	475	470
Response Time	sec.	closing / Opening	0.017 / 0.108

Paper Speed 2 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles/ seconds

9 Cycles

Test Parameter	Units	Required	Actual
Chamber Temperature	°F	+160	160
Specimen Temperature	°F	+160	157
Inlet Pressure	psig	80 maximum	57
Flow (GN_2)	gpm	31 maximum at 160°F	N/A
Actuator Pressure	psig	475	473
Response Time	sec.	Closing / Opening	0.017 / 0.108

Paper Speed 2 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles/ seconds

FORMAL QUALIFICATION TEST DATA SHEET

Repeat Cycle Test Per Paragraph: 5.19 Test Plan Line Item: FQ-F-14A

10 Cycles

Test Parameter	Units	Required	Actual
Chamber Temperature	°F	+160	160
Specimen Temperature	°F	+160	157
Inlet Pressure	psig	80 maximum	57
Flow (GN_2)	gpm	31 maximum at 160°F	N/A
Actuator Pressure	psig	475	473
Response Time	sec.	Closing	0.017
		Opening	0.108

Paper Speed 2 inch/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles / seconds

11 Cycles

Test Parameter	Units	Required	Actual
Chamber Temperature	°F	+160	160
Specimen Temperature	°F	+160	158
Inlet Pressure	psig	80 maximum	57
Flow (GN_2)	gpm	31 maximum at 160°F	N/A
Actuator Pressure	psig	475	473
Response Time	sec.	Closing	0.017
		Opening	0.108

Paper Speed 2 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles / seconds

12 Cycles

Test Parameter	Units	Required	Actual
Chamber Temperature	°F	+160	160
Specimen Temperature	°F	+160	158
Inlet Pressure	psig	80 maximum	57
Flow (GN_2)	gpm	31 maximum at 160°F	N/A
Actuator Pressure	psig	475	472
Response Time	sec.	Closing	0.017
		Opening	0.105

Paper Speed 2 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles / seconds

FORMAL QUALIFICATION TEST DATA SHEET

Repeat Cycle Test Per Paragraph: 5.19 Test Plan Line Item: FQ-F-14A

13 Cycles

Test Parameter	Units	Required	Actual
Chamber Temperature	°F	+160	160
Specimen Temperature	°F	+160	158
Inlet Pressure	psig	80 maximum	57
Flow (GN_2)	gpm	31 maximum at 160°F	N/A
Actuator Pressure	psig	475	472
Response Time	sec.	Closing	0.015
		Opening	0.105

Paper Speed 2 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles / seconds

14 Cycles

Test Parameter	Units	Required	Actual
Chamber Temperature	°F	+160	160
Specimen Temperature	°F	+160	158
Inlet Pressure	psig	80 maximum	57
Flow (GN_2)	gpm	31 maximum at 160°F	N/A
Actuator Pressure	psig	475	472
Response Time	sec.	Closing	0.015
		Opening	0.105

Paper Speed 2 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles / seconds

15 Cycles

Test Parameter	Units	Required	Actual
Chamber Temperature	°F	+160	160
Specimen Temperature	°F	+160	158
Inlet Pressure	psig	80 maximum	Not Recorded
Flow (GN_2)	gpm	31 maximum at 160°F	N/A
Actuator Pressure	psig	475	Not Recorded
Response Time	sec.	--	Not Recorded

Paper Speed Hung up in/sec. Flow Scale N/A gpm/inch

Pressure Scale Not Recorded psig/inch Time Base Not Recorded seconds

FORMAL QUALIFICATION TEST DATA SHEET

Repeat Cycle Test Per Paragraph 5.19 Test Plan Line Item: FQ-F-14A

16 Cycles

Test Parameter	Units	Required	Actual
Chamber Temperature	°F	+160	160
Specimen Temperature	°F	+160	158
Inlet Pressure	psig	80 maximum	57
Flow (100%)	gpm	31 maximum at 160°F	N/A
Actuator Pressure	psig	475	472
Response Time	sec.	Closing	0.015
		Opening	0.105

Paper speed 2 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles/ seconds

17 Cycles

Test Parameter	Units	Required	Actual
Chamber Temperature	°F	+160	160
Specimen Temperature	°F	+160	159
Inlet Pressure	psig	80 maximum	57
Flow (100%)	gpm	31 maximum at 160°F	N/A
Actuator Pressure	psig	475	470
Response Time	sec.	Closing	0.015
		Opening	0.105

Paper speed 2 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles/ seconds

18 Cycles

Test Parameter	Units	Required	Actual
Chamber Temperature	°F	+160	160
Specimen Temperature	°F	+160	160
Inlet Pressure	psig	80 maximum	57
Flow (100%)	gpm	31 maximum at 160°F	N/A
Actuator Pressure	psig	475	470
Response Time	sec.	Closing	0.015
		Opening	0.105

Paper speed 2 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles/ seconds

FORMAL QUALIFICATION TEST DATA SHEET

Repeat Cycle Test Per Paragraph: 5.19 Test Plan Line Item: FQ-F-14A

19 Cycles

Test Parameter	Units	Required	Actual
Chamber Temperature	°F	+160	160
Specimen Temperature	°F	+160	160
Inlet Pressure	psig	80 maximum	56
Flow (GN_2)	gpm	31 maximum at 160°F	N/A
Actuator Pressure	psig	475	470
Response Time	sec.	Closing	0.015
		Opening	0.105

Paper Speed 2 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles / seconds

20 Cycles

Test Parameter	Units	Required	Actual
Chamber Temperature	°F	+160	160
Specimen Temperature	°F	+160	161
Inlet Pressure	psig	80 maximum	56
Flow (GN_2)	gpm	130 maximum at 160°F	N/A
Actuator Pressure	psig	475	470
Response Time	sec.	Closing	0.015
		Opening	0.105

Paper Speed 2 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles / seconds

21 Cycles

Test Parameter	Units	Required	Actual
Chamber Temperature	°F	+160	160
Specimen Temperature	°F	+160	160
Inlet Pressure	psig	80 maximum	56
Flow (GN_2)	gpm	31 maximum at 160°F	N/A
Actuator Pressure	psig	475	465
Response Time	sec.	Closing	0.015
		Opening	0.105

Paper Speed 2 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles / seconds

FORMAL QUALIFICATION TEST DATA SHEET

Repeat Cycle Test Per Paragraph 5.19 Test Plan Line Item: FQ-F-14A

22 Cycles

Test Parameter	Units	Required	Actual
Chamber Temperature	°F	+160	160
Specimen Temperature	°F	+160	161
Inlet Pressure	psig	80 maximum	56
Flow (GN_2)	gpm	31 maximum at 160°F	N/A
Actuator Pressure	psig	475	460
Response Time	sec.	Closing	0.016
		Opening	0.106

Paper Speed 2 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles / seconds

23 Cycles

Test Parameter	Units	Required	Actual
Chamber Temperature	°F	+160	160
Specimen Temperature	°F	+160	159
Inlet Pressure	psig	80 maximum	56
Flow (GN_2)	gpm	31 maximum at 160°F	N/A
Actuator Pressure	psig	475	460
Response Time	sec.	Closing	0.017
		Opening	0.107

Paper Speed 2 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles / seconds

24 Cycles

Test Parameter	Units	Required	Actual
Chamber Temperature	°F	+160	160
Specimen Temperature	°F	+160	160
Inlet Pressure	psig	80 maximum	56
Flow (GN_2)	gpm	31 maximum at 160°F	N/A
Actuator Pressure	psig	475	458
Response Time	sec.	Closing	0.017
		Opening	0.108

Paper Speed 25 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles / seconds

FORMAL QUALIFICATION TEST DATA SHEET

Repeat Cycle Test Per Paragraph: 5.19 Test Plan Line Item: FQ-F-14A

25 Cycles

Test Parameter	Units	Required	Actual
Chamber Temperature	°F	+160	160
Specimen Temperature	°F	+160	160
Inlet Pressure	psig	80 maximum	66
Flow (GN_2)	gpm	31 maximum at 160°F	N/A
Actuator Pressure	psig	475	475
Response Time	sec.	Closing	0.0165
		Opening	0.108

Paper Speed 2 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles/ seconds

26 Cycles

Test Parameter	Units	Required	Actual
Chamber Temperature	°F	+160	160
Specimen Temperature	°F	+160	160
Inlet Pressure	psig	80 maximum	68
Flow (GN_2)	gpm	31 maximum at 160°F	N/A
Actuator Pressure	psig	475	470
Response Time	sec.	Closing	0.017
		Opening	0.108

Paper Speed 2 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles/ seconds

27 Cycles

Test Parameter	Units	Required	Actual
Chamber Temperature	°F	+160	160
Specimen Temperature	°F	+160	160
Inlet Pressure	psig	80 maximum	55
Flow (GN_2)	gpm	31 maximum at 160°F	N/A
Actuator Pressure	psig	475	462
Response Time	sec.	Closing	0.017
		Opening	0.108

Paper Speed 2 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles/ seconds

FORMAL QUALIFICATION TEST DATA SHEET

Repeat Cycle Test Per Paragraph: 5.19 Test Plan Line Item: FQ-F-14A

28 Cycles

Test Parameter	Units	Required	Actual
Chamber Temperature	°F	+160	160
Specimen Temperature	°F	+160	159
Inlet Pressure	psig	80 maximum	54
Flow (GN_2)	gpm	31 maximum 160°F	N/A
Actuator Pressure	psig	475	472
Response Time	sec.	Closing	0.017
		Opening	0.108

Paper Speed 2 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles / seconds

29 Cycles

Test Parameter	Units	Required	Actual
Chamber Temperature	°F	+160	160
Specimen Temperature	°F	+160	160
Inlet Pressure	psig	80 maximum	62
Flow (GN_2)	gpm	31 maximum at 160°F	N/A
Actuator Pressure	psig	475	470
Response Time	sec.	Closing	0.017
		Opening	0.108

Paper Speed 2 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles / seconds

30 Cycles

Test Parameter	Units	Required	Actual
Chamber Temperature	°F	+160	160
Specimen Temperature	°F	+160	160
Inlet Pressure	psig	80 maximum	63
Flow (GN_2)	gpm	31 maximum at 160°F	N/A
Actuator Pressure	psig	475	470
Response Time	sec.	Closing	0.017
		Opening	0.108

Paper Speed 2 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles / seconds

FORMAL QUALIFICATION TEST DATA SHEET

Repeat Cycle Test Per Paragraph: 5.19 Test Plan Line Item: FQ-F-14A

31 Cycles

Test Parameter	Units	Required	Actual
Chamber Temperature	°F	+160	160
Specimen Temperature	°F	+160	160
Inlet Pressure	psig	80 maximum	63
Flow (GN_2)	gpm	31 maximum at 160°F	N/A
Actuator Pressure	psig	475	465
Response Time	sec.	Closing	0.017
		Opening	0.108

Paper Speed 2 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles / seconds

32 Cycles

Test Parameter	Units	Required	Actual
Chamber Temperature	°F	+160	160
Specimen Temperature	°F	+160	160
Inlet Pressure	psig	80 maximum	62
Flow (GN_2)	gpm	31 maximum at 160°F	N/A
Actuator Pressure	psig	475	468
Response Time	sec.	Closing	0.017
		Opening	0.108

Paper Speed 2 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles / seconds

33 Cycles

Test Parameter	Units	Required	Actual
Chamber Temperature	°F	+160	160
Specimen Temperature	°F	+160	159
Inlet Pressure	psig	80 maximum	63
Flow (GN_2)	gpm	31 maximum at 160°F	N/A
Actuator Pressure	psig	475	465
Response Time	sec.	Closing	0.017
		Opening	0.108

Paper Speed 2 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles / seconds

FORMAL QUALIFICATION TEST DATA SHEET

Repeat Cycle Test Per Paragraph: 5.19 Test Plan Line Item: FQ-F-14A

34 Cycles

Test Parameter	Units	Required	Actual
Chamber Temperature	°F	+160	160
Specimen Temperature	°F	+160	159
Inlet Pressure	psig	80 maximum	63
Flow (GPM)	gpm	31 maximum at 160°F	N/A
Actuator Pressure	psig	475	465
Response Time	sec.	Closing	0.017
		Opening	0.108

Paper Speed 2 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles / seconds

22 Cycles

Test Parameter	Units	Required	Actual
Chamber Temperature	°F	+160	160
Specimen Temperature	°F	+160	159
Inlet Pressure	psig	80 maximum	63
Flow (GPM)	gpm	31 maximum at 160°F	N/A
Actuator Pressure	psig	475	465
Response Time	sec.	Closing	0.017
		Opening	0.108

Paper Speed 2 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles / seconds

Hi Cycles

Test Parameter	Units	Required	Actual
Chamber Temperature	°F	+160	160
Specimen Temperature	°F	+160	158
Inlet Pressure	psig	80 maximum	62
Flow (GPM)	gpm	31 maximum at 160°F	N/A
Actuator Pressure	psig	475	465
Response Time	sec.	Closing	0.017
		Opening	0.108

Paper Speed 2 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles / seconds

FORMAL QUALIFICATION TEST DATA SHEET

Repeat Cycle Test Per Paragraph: 5.19 Test Plan Line Item: FQ-F-14A

37 Cycles

Test Parameter	Units	Required	Actual
Chamber Temperature	°F	+160	160
Specimen Temperature	°F	+160	158
Inlet Pressure	psig	80 maximum	62
Flow (GN_2)	gpm	31 maximum at 160°F	N/A
Actuator Pressure	psig	475	470
Response Time	sec.	Closing	0.017
		Opening	0.108

Paper Speed 2 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles / seconds

38 Cycles

Test Parameter	Units	Required	Actual
Chamber Temperature	°F	+160	160
Specimen Temperature	°F	+160	158
Inlet Pressure	psig	80 maximum	63
Flow (GN_2)	gpm	31 maximum at 160°F	N/A
Actuator Pressure	psig	475	468
Response Time	sec.	Closing	0.017
		Opening	0.108

Paper Speed 2 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles / seconds

39 Cycles

Test Parameter	Units	Required	Actual
Chamber Temperature	°F	+160	160
Specimen Temperature	°F	+160	158
Inlet Pressure	psig	80 maximum	62
Flow (GN_2)	gpm	31 maximum at 160°F	N/A
Actuator Pressure	psig	475	465
Response Time	sec.	Closing	0.017
		Opening	0.108

Paper Speed 2 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles / seconds

FORMAL QUALIFICATION TEST DATA SHEET

Repeat Cycle Test Per Paragraph 5.19 Test Plan Line Item: FQ-F-14A

40 Cycles

Test Parameter	Units	Required	Actual
Chamber Temperature	°F	+160	160
Specimen Temperature	°F	+160	159
Inlet Pressure	psig	80 maximum	63
Flow (GN_2)	gpm	31 maximum at 160°F	N/A
Actuator Pressure	psig	475	468
Response Time	sec.	Closing	0.017
		Opening	0.108

Paper Speed 2 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles / seconds

41 Cycles

Test Parameter	Units	Required	Actual
Chamber Temperature	°F	+160	160
Specimen Temperature	°F	+160	159
Inlet Pressure	psig	80 maximum	62
Flow (GN_2)	gpm	31 maximum at 160°F	N/A
Actuator Pressure	psig	475	465
Response Time	sec.	Closing	0.017
		Opening	0.108

Paper Speed 2 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles / seconds

42 Cycles

Test Parameter	Units	Required	Actual
Chamber Temperature	°F	+160	160
Specimen Temperature	°F	+160	159
Inlet Pressure	psig	80 maximum	63
Flow (GN_2)	gpm	31 maximum at 160°F	N/A
Actuator Pressure	psig	475	465
Response Time	sec.	Closing	0.017
		Opening	0.108

Paper Speed 2 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles / seconds

FORMAL QUALIFICATION TEST DATA SHEET

Repeat Cycle Test Per Paragraph: 5.19 Test Plan Line Item: FQ-F-14A

43 Cycles

Test Parameter	Units	Required	Actual
Chamber Temperature	°F	+160	160
Specimen Temperature	°F	+160	160
Inlet Pressure	psig	80 maximum	63
Flow (GK_2)	gpm	31 maximum at 160°F	N/A
Actuator Pressure	psig	475	470
Response Time	sec.	Closing	0.017
		Opening	0.107

Paper Speed 2 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles/ seconds

44 Cycles

Test Parameter	Units	Required	Actual
Chamber Temperature	°F	+160	160
Specimen Temperature	°F	+160	160
Inlet Pressure	psig	80 maximum	62
Flow (GK_2)	gpm	31 maximum at 160°F	N/A
Actuator Pressure	psig	475	470
Response Time	sec.	Closing	0.017
		Opening	0.106

Paper Speed 2 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles/ seconds

45 Cycles

Test Parameter	Units	Required	Actual
Chamber Temperature	°F	+160	160
Specimen Temperature	°F	+160	160
Inlet Pressure	psig	80 maximum	62
Flow (GK_2)	gpm	31 maximum at 160°F	N/A
Actuator Pressure	psig	475	470
Response Time	sec.	Closing	0.017
		Opening	0.105

Paper Speed 2 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles/ seconds

FORMAL QUALIFICATION TEST DATA SHEET

Repeat Cycle Test Per Paragraph: 5.19 Test Plan Line Item: FQ-F-14A

46 Cycles

Test Parameter	Units	Required	Actual
Chamber Temperature	°F	+160	160
Specimen Temperature	°F	+160	160
Inlet Pressure	psig	80 maximum	63
Flow (GN_2)	gpm	31 maximum at 160°F	N/A
Actuator Pressure	psig	475	470
Response Time	sec.	Closing Opening	0.017 0.105

Paper Speed 2 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles/ seconds

47 Cycles

Test Parameter	Units	Required	Actual
Chamber Temperature	°F	+160	160
Specimen Temperature	°F	+160	160
Inlet Pressure	psig	80 maximum	62
Flow (GN_2)	gpm	31 maximum at 160°F	N/A
Actuator Pressure	psig	475	470
Response Time	sec.	Closing Opening	0.017 0.106

Paper Speed 2 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles/ seconds

48 Cycles

Test Parameter	Units	Required	Actual
Chamber Temperature	°F	+160	160
Specimen Temperature	°F	+160	160
Inlet Pressure	psig	80 maximum	62
Flow (GN_2)	gpm	31 maximum at 160°F	N/A
Actuator Pressure	psig	475	470
Response Time	sec.	Closing Opening	0.017 0.106

Paper Speed 2 in/sec. Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles/ seconds

FORMAL QUALIFICATION TEST DATA SHEET

Repeat Cycle Test Per Paragraph: 5.19 Test Plan Line Item: FQ-F-14A

49 Cycles

Test Parameter	Units	Required	Actual
Chamber Temperature	°F	+160	160
Specimen Temperature	°F	+160	160
Inlet Pressure	psig	80 maximum	62
Flow (GR_2)	gpm	31 maximum at 160°F	N/A
Actuator Pressure	psig	475	470
Response Time	sec.	Closing	0.017
		Opening	0.098

Paper Speed 25 in/sec. Flow Scale 3 N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles / seconds

50 Cycles

Test Parameter	Units	Required	Actual
Chamber Temperature	°F	+160	160
Specimen Temperature	°F	+160	159
Inlet Pressure	psig	80 maximum	30
Flow (GR_2)	gpm	31 maximum at 160°F	N/A
Actuator Pressure	psig	475	475
Response Time	sec.	Closing	0.017
		Opening	0.098

Paper Speed 25 in/sec. Flow Scale 3 N/A gpm/inch

Pressure Scale 20 psig/inch Time Base 500 cycles / seconds

Accept: X Reject:

Comment:

FORMAL QUALIFICATION TEST DATA SHEET

Item Name: LO_2 Chilldown System Shutoff Valve

Part Number: 1A49965-521

Test Procedure Drawing No: 1T07783 Change Letter: C

Manufacturer's S/N: 0201 Test Plan Line Item: FQ-F-14A

Test Laboratory: BEECH AIRCRAFT Location: BOULDER, COLORADO

Douglas Test Representative: K. C. TYLER Date: 10-21-66

Test Witness: _____ Douglas Q.C. _____ Customer Q.C.

Proof Pressure Test Per Paragraph: 5.9 POST REPEAT CYCLE TEST

Test Specimen No: 1

Test Start (Date, Time): 10-21-66, 1316

Test Completed (Date, Time): 10-21-66, 1415

Ambient Room Conditions:

Temperature °F	RH %	Atm. Press. In. Hg abs.
72	26	611.5 mm

Valve Body

Test Parameter	Units	Required	Actual
Temperature	°F	-300 (±20)	-288
Pressure	psig	190	190
Time	minutes	5	5

Actuator

Test Parameter	Units	Required	Actual
Temperature	°F	Ambient	64
Pressure	psig	750	750
Time	minutes	5	5

Accept: X Reject: _____

Comments: _____

FORMAL QUALIFICATION TEST DATA SHEET

Item Name: LO_2 Chilldown System Shutoff Valve

Part Number: 1A49965-521

Test Procedure Drawing No: 1T07783 Change Letter: C

Manufacturer's S/N: 0201 Test Plan Line Item: FQ-F-14A

Test Laboratory: BEECH AIRCRAFT Location: BOULDER, COLORADO

Douglas Test Representative: K.C. TOLIDES Date: 10-21-66

Test Witness: H. N Pratt (Douglas Q. C.) (Customer Q. C.)

Internal Leakage Test Per Paragraph: 5.10.2 FOUR REPEAT CYCLE TEST

Test Specimen No: 1

Test Start (Date, Time): 10-21-66, 1415

Test Completed (Date, Time): 10-21-66, 2350

Ambient Room Conditions:	Temperature °F	RH %	Atm. Press. In. Hg abs.
	70	25	613.5 mm
	66	28	613.5 mm

Gate Seal

Test Parameter	Units	Required	Actual
Specimen Temperature	°F	Stabilized	-288
Inlet Pressure	psig	80 Maximum	80
Actuator Port Pressure	psig	475	475
Leakage Rate	scim	30	2.5
Time Maintained	minutes	5	5

Actuator

Test Parameter	Units	Required	Actual
Actuator Port Pressure	psig	475	475
Specimen Temperature	°F	Ambient	65
Leakage Rate	scch	1.0	4.7×10^{-6}
Maintained	minutes	5	5

FORMAL QUALIFICATION TEST DATA SHEET

Item Name: LO_2 Chilldown System Shutoff Valve

Part Number: LA49965-521

Test Procedure Drawing No: LT07783 Change Letter: C

Manufacturer's S/N: 0201 Test Plan Line Item: FQ-F-14A

Test Laboratory: BEECH AIRCRAFT Location: BOULDER, COLORADO

Douglas Test Representative: K.C. TOLIDES Date: 10-22-66

Test Witness: _____ Douglas Q.C. _____ Customer Q.C.

Functional Test Per Paragraph: 5.11 Post Repeat Cycle Test

Test Specimen No: 1

Test Start (Date, Time): 10-22-66, 0300

Test Completed (Date, Time): 10-22-66, 0330

Ambient Room Conditions:	Temperature °F	RH %	Atm. Press. In. Hg abs.
	62	38	617 mm

Response Time

Test Parameter	Units	Required	Actual
Specimen Temperature	°F	Stabilized	-292
Pressure (Inlet)	psig	80 max.	22
Flow	gpm	31 max.	N/A
Pressure (Actuator)	psig	475	475
Response Time	sec.	Closing	0.050

Paper Speed 25 in/sec.

Flow Scale N/A gpm/inch

Pressure Scale 20 psig/inch

Time Base 500 cycles/ seconds

Accept: X Reject: _____

Comment: _____

FORMAL QUALIFICATION TEST DATA SHEET

Functional Test Per Paragraph: 5.19 Test Plan Line Item: FQ-F-14A

Position Indicator

A. Temperature Stabilized -292 OPEN Indicator Light ON ON

B. Outlet Pressure Zero 0 CLOSED Indicator Light ON ON

C. Actuator Pressure Zero 0 OPEN Indicator Light ON ON

D. Temperature at Ambient 62 OPEN Indicator Light ON ON

Accept: X Reject:

Comment:

Dielectric Strength

Test Parameter	Units	Required	Actual
Voltage	vac rms	1000	
Frequency	cps	60	
Rate of Application	volts/sec.	250 maximum	
Time	minutes	1	
Leakage Current	microamperes	200	

Accept: Reject:

Comment: THIS TEST WAS NOT PERFORMED AT THIS TIME

Insulation Resistance

Test Parameter	Units	Required	Actual
Voltage	vdc	500	500
Insulation Resistance	megohms	100 minimum	> 100

Accept: X Reject:

Comments: ALL READINGS WERE IN EXCESS OF 100 MEGOHMS.

Bonding Resistance

Test Parameter	Units	Required	Actual
Resistance	ohms	0.1 maximum	< 0.1

Accept: X Reject:

Comments:

FORMAL QUALIFICATION TEST DATA SHEET

Functional Test Per Paragraph: 5.19 Test Plan Line Item: FQ-F-14A

Continuity Check (Open Position)

Test Parameter	Units	Required	Actual			
Continuity	ohms	0.25 maximum	A-B	D-E	G-H	K-L
			SEE COMMENT			
No Continuity	megohms	20 minimum	B-C	E-F	H-J	L-M
			SEE COMMENT			

Accept: X Reject: _____

Comment: ALL PINS WERE LESS THAN 0.25 OHMS.
ALL PINS WERE GREATER THAN 20 MEGOHMS.

Continuity Check (Closed Position)

Test Position	Units	Required	Actual			
Continuity	ohms	0.25 maximum	B-C	E-F	J-H	L-M
			SEE COMMENT			
No Continuity	megohms	20 minimum	A-B	D-E	G-H	K-L
			SEE COMMENT			

Accept: X Reject: _____

Comment: ALL PINS WERE LESS THAN 0.25 OHMS.
ALL PINS WERE GREATER THAN 20 MEGOHMS.

FORMAL QUALIFICATION TEST DATA SHEET

Item Name: LO_2 Chilldown System Shutoff Valve

Part Number: 1A49965-521

Test Procedure Drawing No.: 1T07783 Change Letter: C

Manufacturer's S/N: 0201 Test Plan Line Item: FQ-F-14A

Test Laboratory: Beech Aircraft Location: Boulder, Colorado

Douglas Test Representative: K. C. Tolides Date 10-26-66

Test Witness: _____ Douglas Q.C. _____ Customer Q.C.

Vibration Test Per Paragraph: 5.15

Test Specimen No.: 1

	Sine	Random
Test Start (Date, Time):	10-26-66 @ 0530	10-27-66 @ 0245
Test Completed (Date, Time):	10-26-66 @ 0600	10-27-66 @ 0320

Ambient Room Conditions:

Temperature °F	RH %	Atm. Press. In Hg Abs.
74	22	620 mm

Sinusoidal Sweep Test Axis Orientation: THRUST "A"

	Sweep Rate Octave/Minute	Frequency cps	Amplitude
Required	1.0	5 to 24	0.032 In. D.A.
Actual	NOTE: Sweep Rates Approx. 1.0 Oct/Min.	5 TO 24	0.032 IN. D.A.
Required		24 to 47	1.0 G Peak
Actual		24 TO 47	1.0 G PEAK
Required		47 to 200	0.0088 In. D.A.
Actual		47 TO 200	0.0088 IN. D.A.
Required	Total Run Time	200 to 2000	17.5 G Peak
Actual	21 Min. 04 Sec.	200 TO 2000	17.5 G. PEAK

FORMAL QUALIFICATION TEST DATA SHEET

Vibration Test Per Paragraph: 5.15 Test Plan Line Item: EQ-F-14A

Axis Orientation: THRUST "A" P/N: 1A49965-521

Random Vibration Test Specimen No.: 1 S/N: 0201 Date: 10-26-66

	Time Applied (Minutes)	Frequency cps	Amplitude
Required	12	20 to 60	$0.01G^2$/cps
Actual	12	*	*
Required	12	60 to 120	+10db/Octave
Actual	12	*	*
Required	12	120 to 2000	$0.1G^2$/cps
Actual	12	*	*

Accept: X Reject:

Comment:

* See Attached Plots

Mechanical Shock Test Per Paragraph: 5.16

Test Start (Date, Time): 10-27-66, @ 0700

Test Completed (Date, Time): 10-27-66, @ 0740

Test Parameter	Units	Required	Actual
Amplitude (1/2 Sine Pulse)	G	20 Peak	20 PEAK
Time	milliseconds	10(±2)	10 (±2)
Amplitude (1/2 Sine Pulse)	G	20 Peak	20 PEAK
Time	milliseconds	10(±2)	10 (±2)
Amplitude (1/2 Sine Pulse)	G	20 Peak	20 PEAK
Time	milliseconds	10(±2)	10 (±2)

DOUGLAS AIRCRAFT COMPANY , INC.

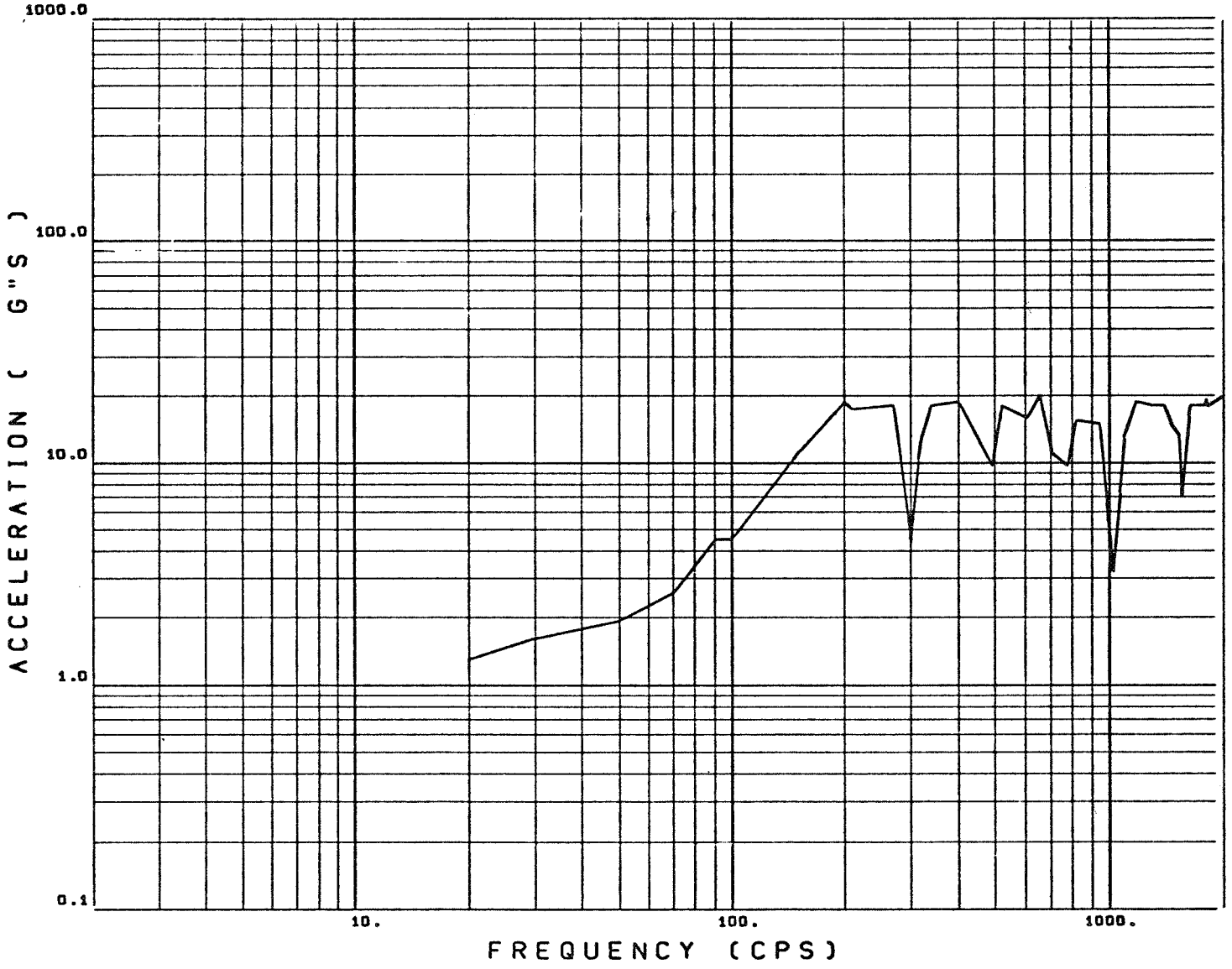
PAGE NO. _____
REPORT NO. _____

SINUSOIDAL FREQUENCY SWEEP
SIV-B CHILLDOWN SHUTOFF VALVE
(FQ F-14A)

CONFIGURATION --- S/N 0201
NOTE... SEE PAGE _____
FOR PICK UP LOCATION

LEGEND...
UPSWEEP ———
DOWNSWEEP ------

TEST CONDITIONS....
TEST DATE..... 10/25/66
AXIS OF EXCITATION.... THRUST
PICK UP NUMBER (1)... 1 FILTERED
PICK UP RESPONSE..... THRUST
INPUT ACCEL.PER PAGE.. _____



DOUGLAS AIRCRAFT COMPANY , INC.

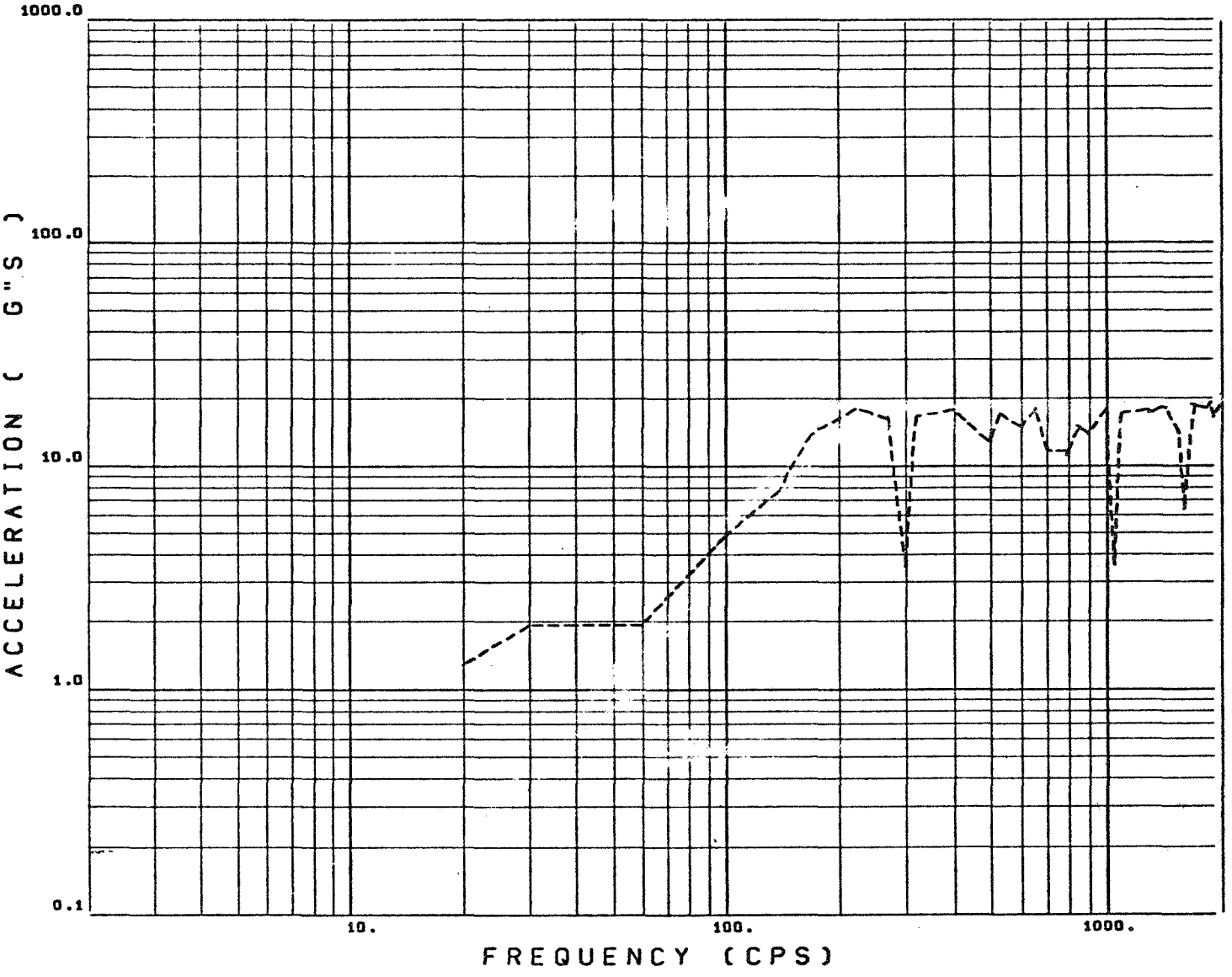
PAGE NO. _____
REPORT NO. _____

SINUSOIDAL FREQUENCY SWEEP
SIV-B CHILLDOWN SHUTOFF VALVE
(FQ F-14A)

CONFIGURATION --- S/N 0201
NOTE... SEE PAGE _____
FOR PICK UP LOCATION

LEGEND...
UPSWEEP ———
DOWNSWEEP ------

TEST CONDITIONS....
TEST DATE..... 10/25/66
AXIS OF EXCITATION.... THRUST
PICK UP NUMBER (1)... 1 FILTERED
PICK UP RESPONSE..... THRUST
INPUT ACCEL.PER PAGE.. _____



DOUGLAS AIRCRAFT COMPANY , INC.

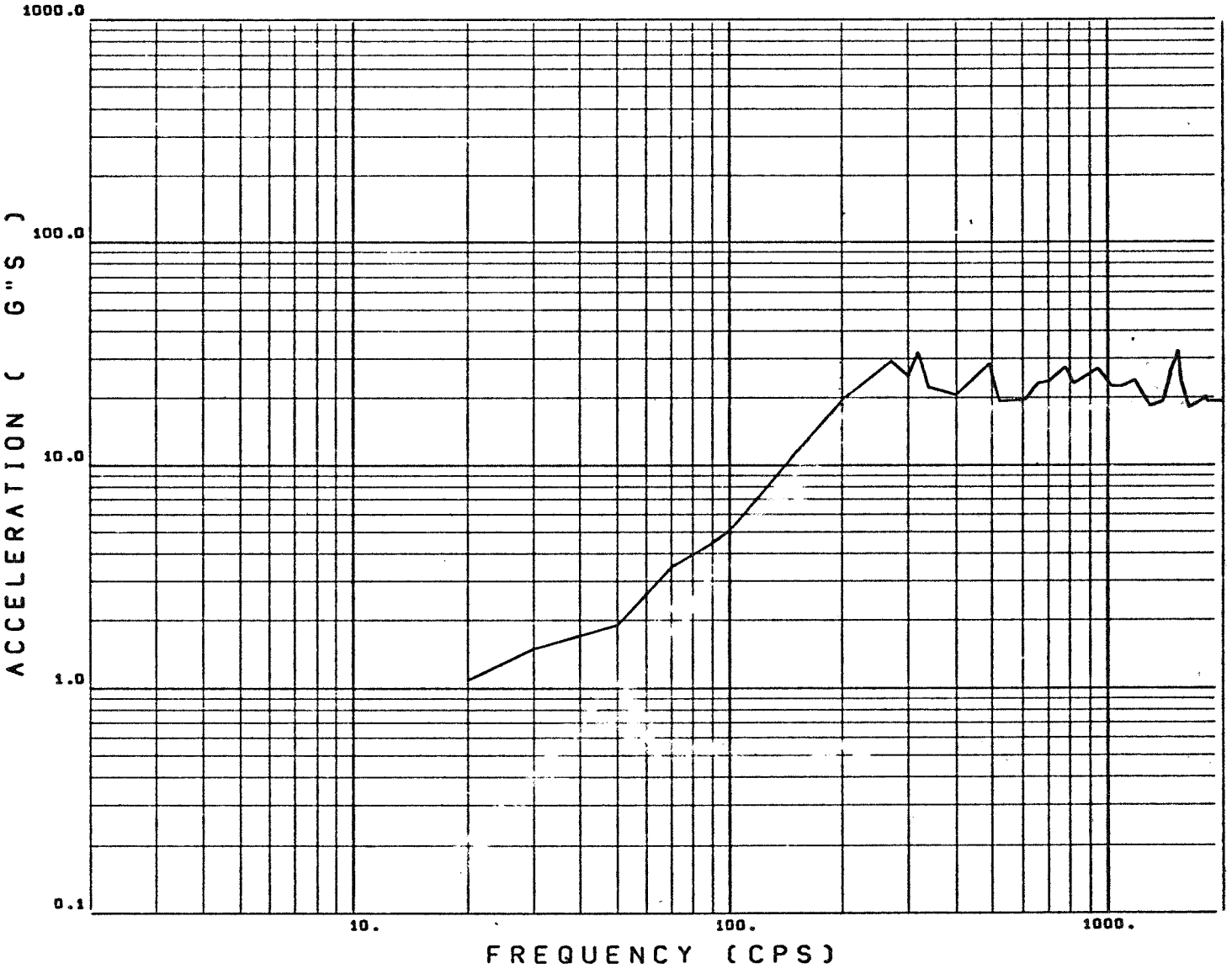
PAGE NO. _____
REPORT NO. _____

SINUSOIDAL FREQUENCY SWEEP
SIV-B CHILLDOWN SHUTOFF VALVE
(FQ F-14A)

CONFIGURATION --- S/N 0201
NOTE... SEE PAGE _____
FOR PICK UP LOCATION

LEGEND...
UPSWEEP ———
DOWNSWEEP ------

TEST CONDITIONS....
TEST DATE..... 10/25/66
AXIS OF EXCITATION.... THRUST
PICK UP NUMBER (1)... 1 UNFILTERED
PICK UP RESPONSE..... THRUST
INPUT ACCEL.PER PAGE.. _____



DOUGLAS AIRCRAFT COMPANY , INC.

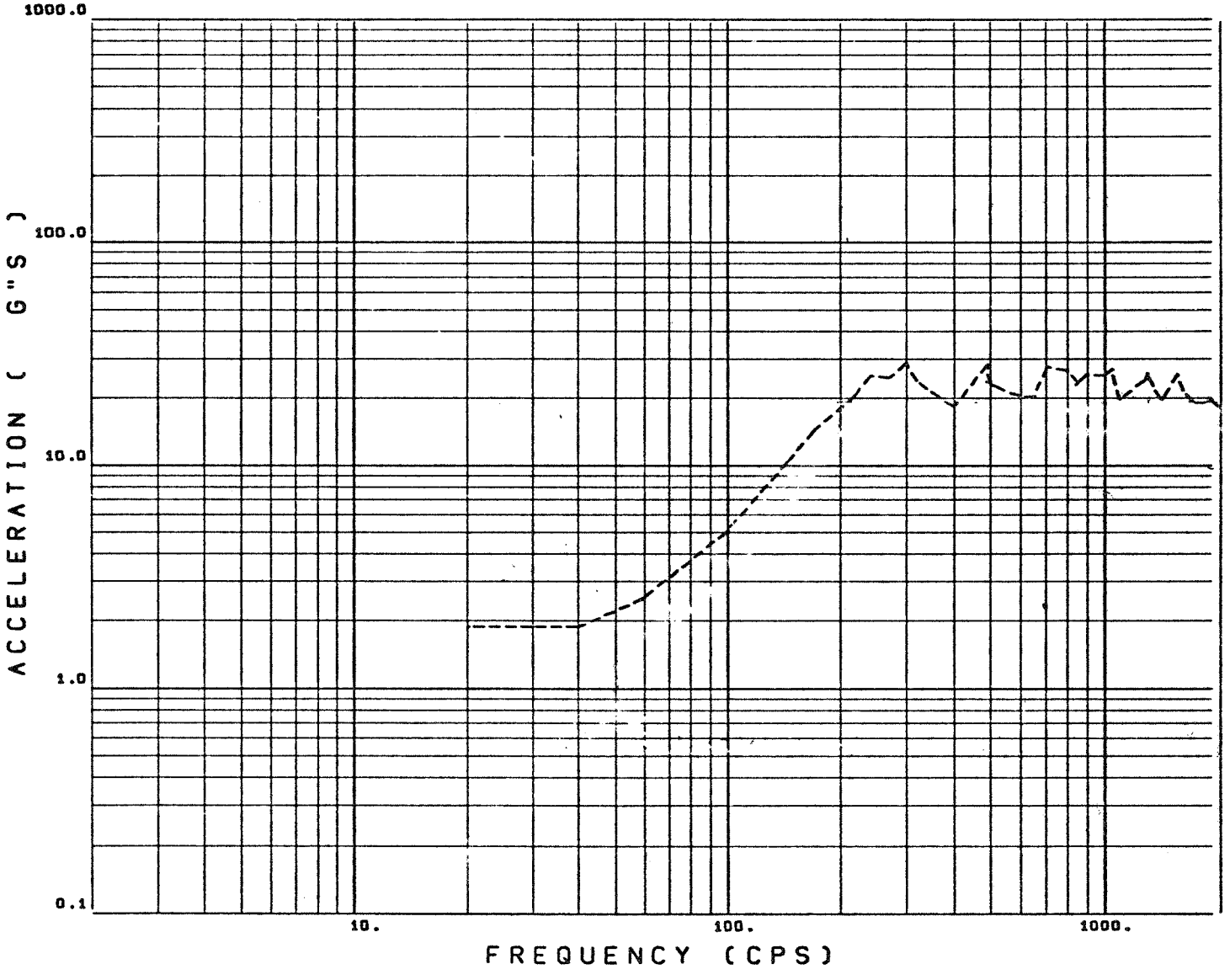
PAGE NO. _____
REPORT NO. _____

SINUSOIDAL FREQUENCY SWEEP
SIV-B CHILLDOWN SHUTOFF VALVE
(FQ F-14A)

CONFIGURATION --- S/N 0201
NOTE... SEE PAGE _____
FOR PICK UP LOCATION

LEGEND...
UPSWEEP ———
DOWNSWEEP ------

TEST CONDITIONS....
TEST DATE..... 10/25/66
AXIS OF EXCITATION.... THRUST
PICK UP NUMBER (1)... 1 UNFILTERED
PICK UP RESPONSE.....
INPUT ACCEL.PER PAGE.. _____



DOUGLAS AIRCRAFT COMPANY , INC.

PAGE NO. _____
REPORT NO. _____

SINUSOIDAL FREQUENCY SWEEP

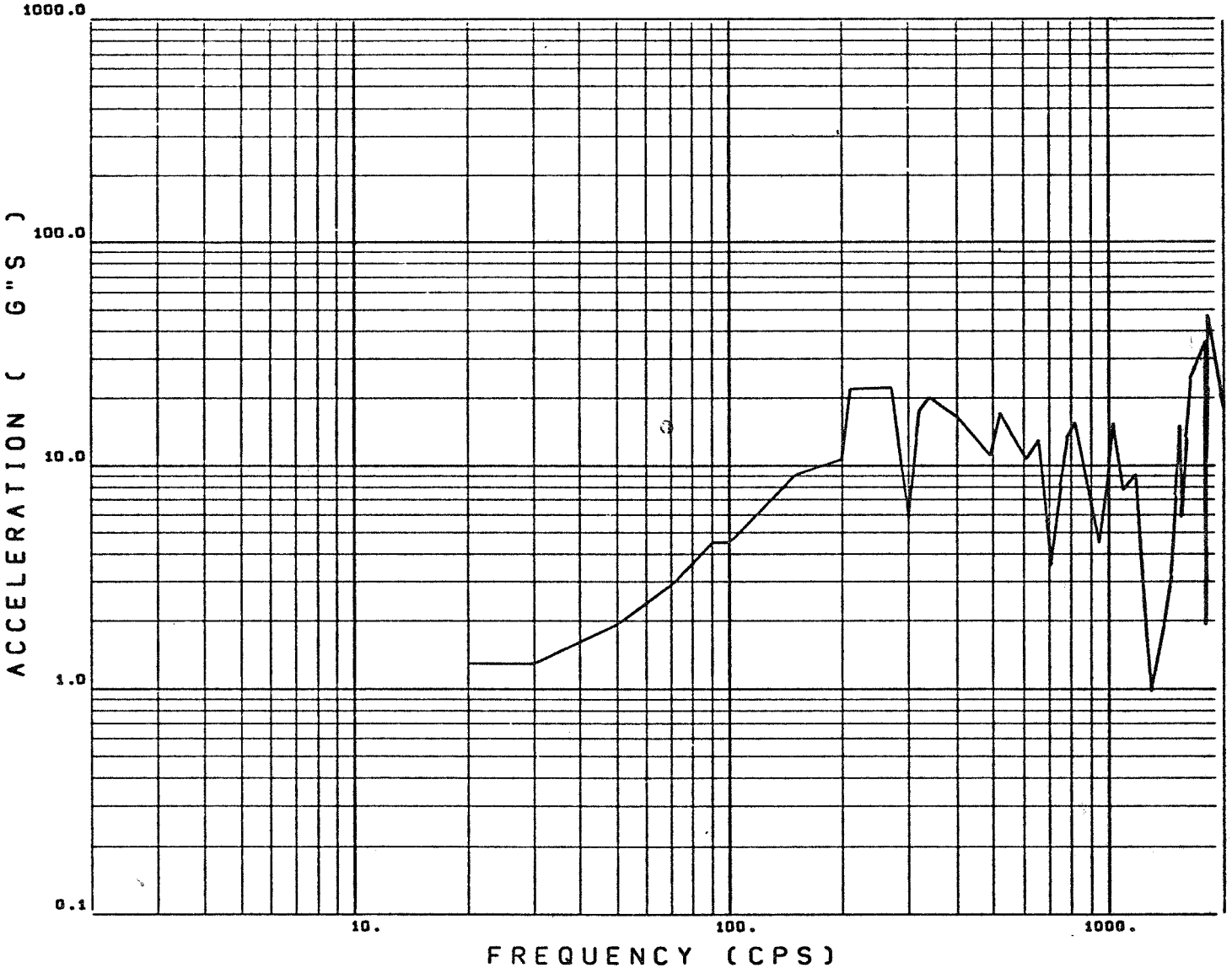
SIV-B CHILLDOWN SHUTOFF VALVE

(FQ F-14A)

CONFIGURATION --- S/N 0201
NOTE... SEE PAGE _____
FOR PICK UP LOCATION

LEGEND...
UPSWEEP ———
DOWNSWEEP ------

TEST CONDITIONS....
TEST DATE..... 10/25/66
AXIS OF EXCITATION.... THRUST
PICK UP NUMBER (2)... 2 FILTERED
PICK UP RESPONSE..... THRUST
INPUT ACCEL.PER PAGE.. _____



DOUGLAS AIRCRAFT COMPANY , INC.

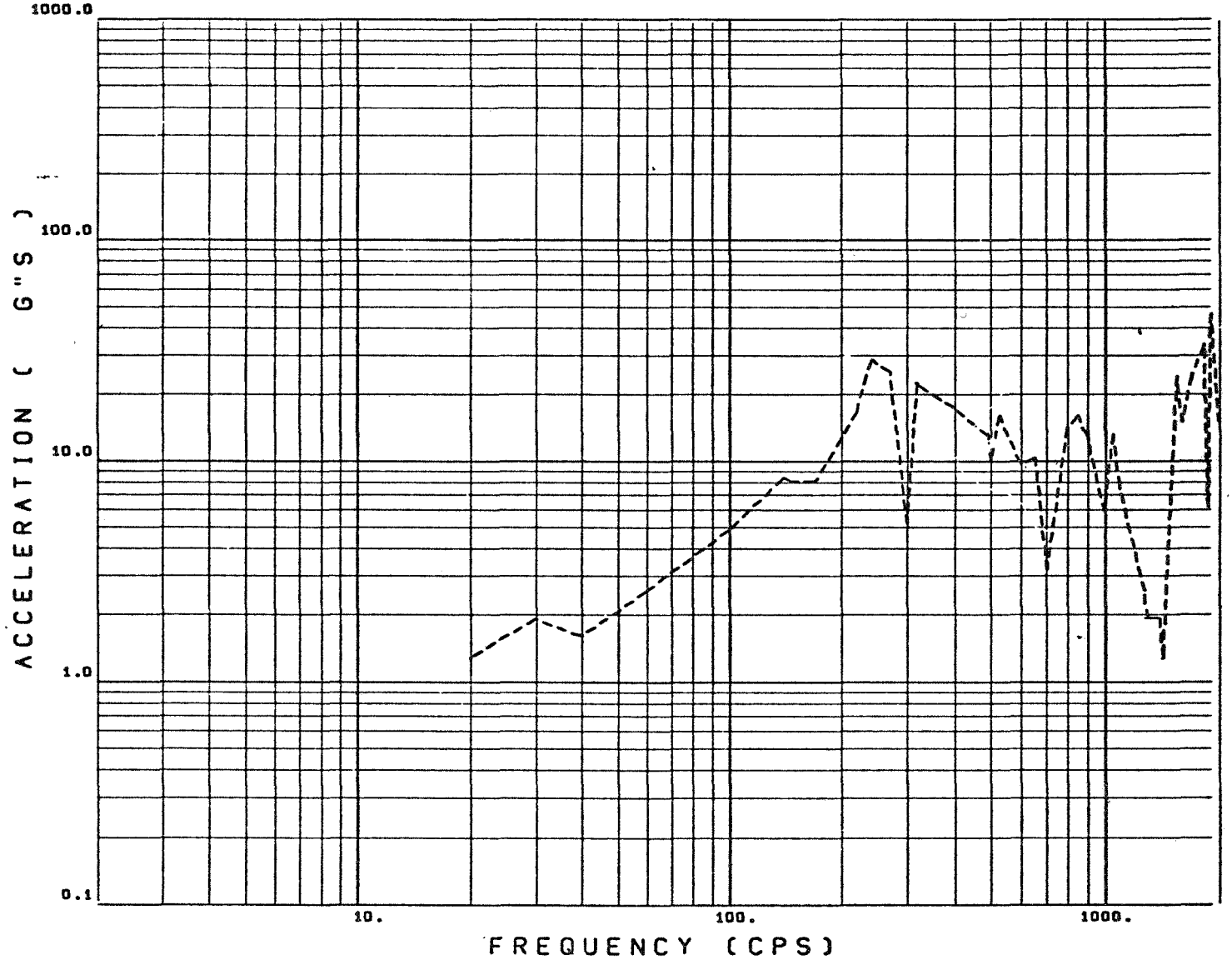
PAGE NO. _____
REPORT NO. _____

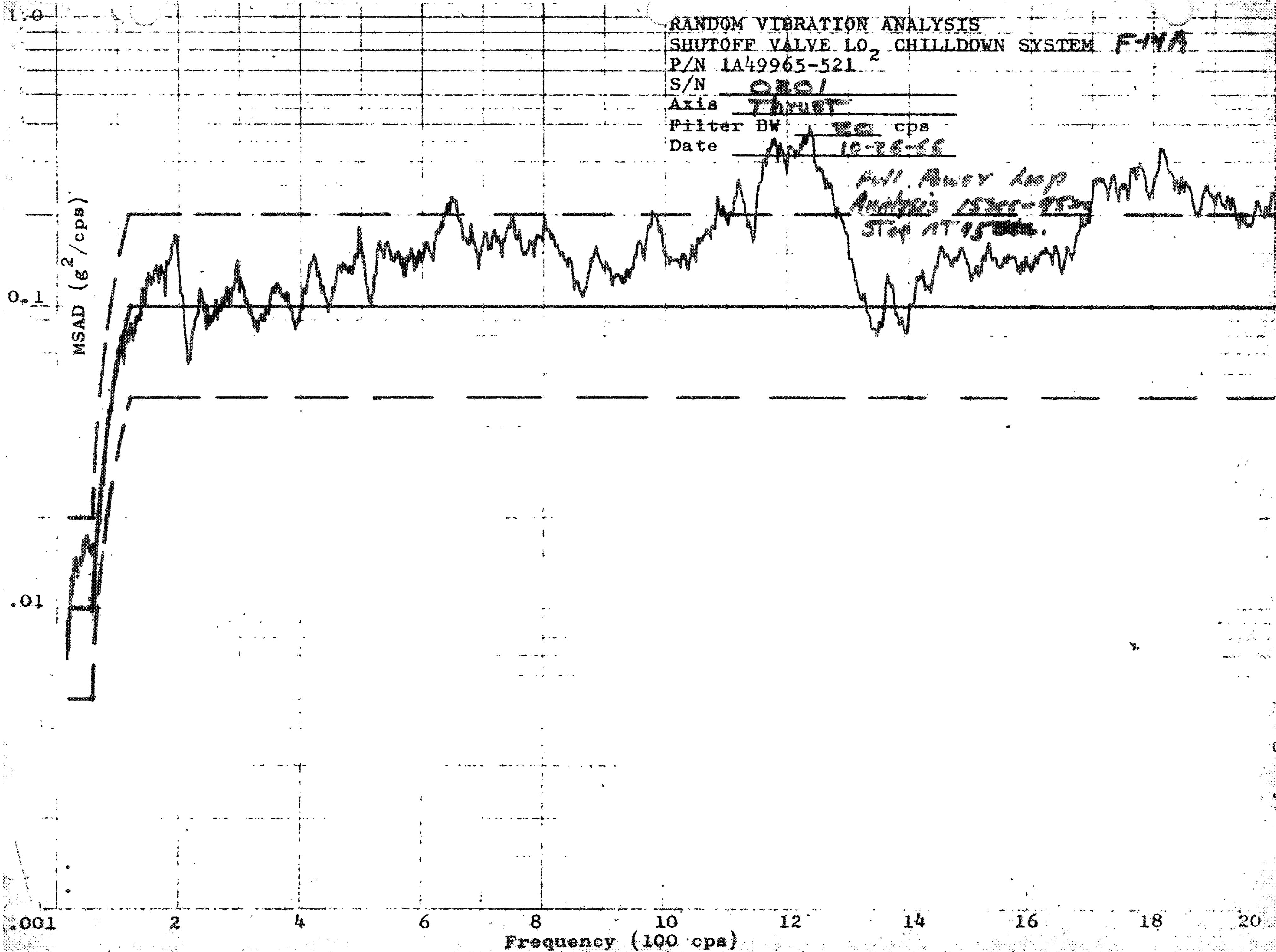
SINUSOIDAL FREQUENCY SWEEP
SIV-B CHILLDOWN SHUTOFF VALVE
(FQ F-14A)

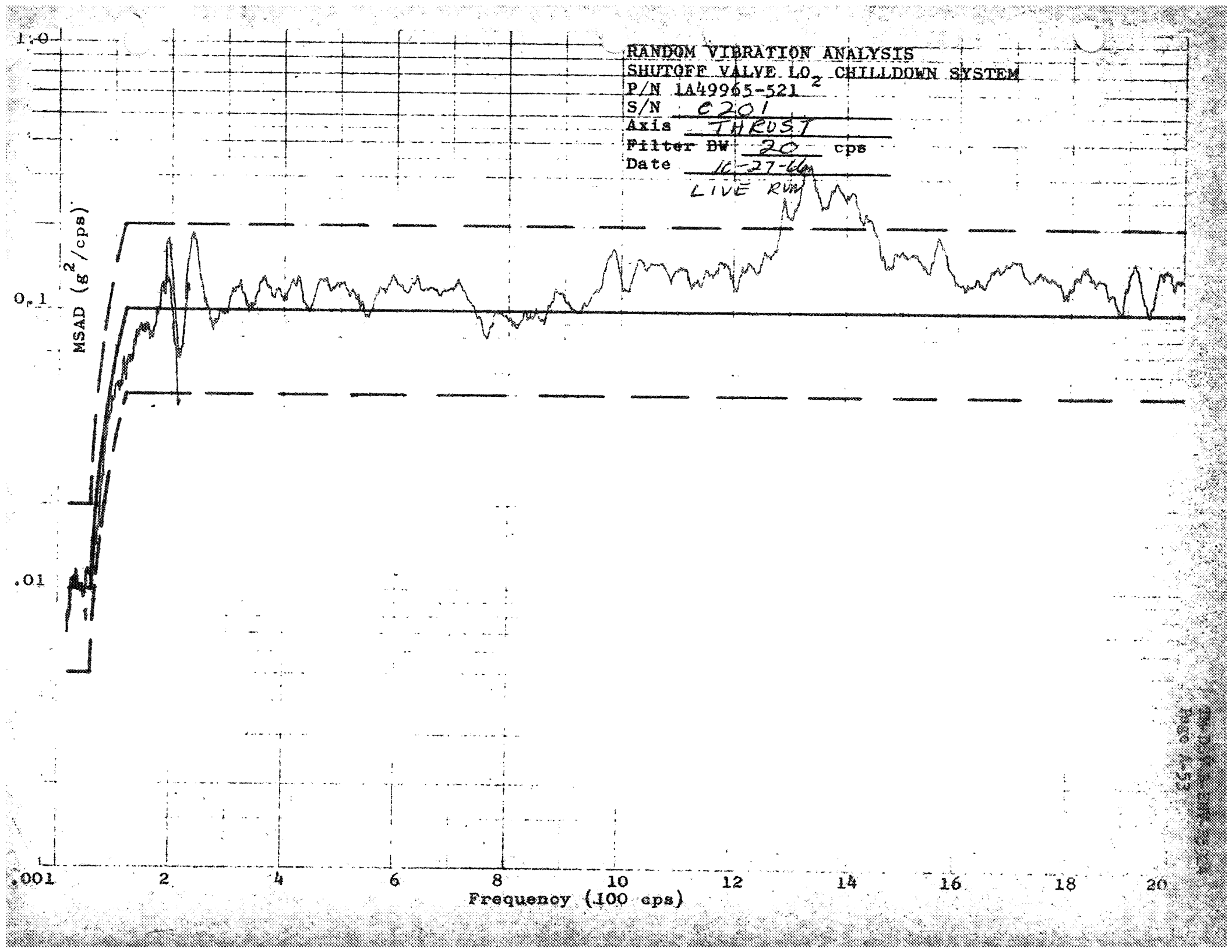
CONFIGURATION --- S/N 0201
NOTE... SEE PAGE _____
FOR PICK UP LOCATION

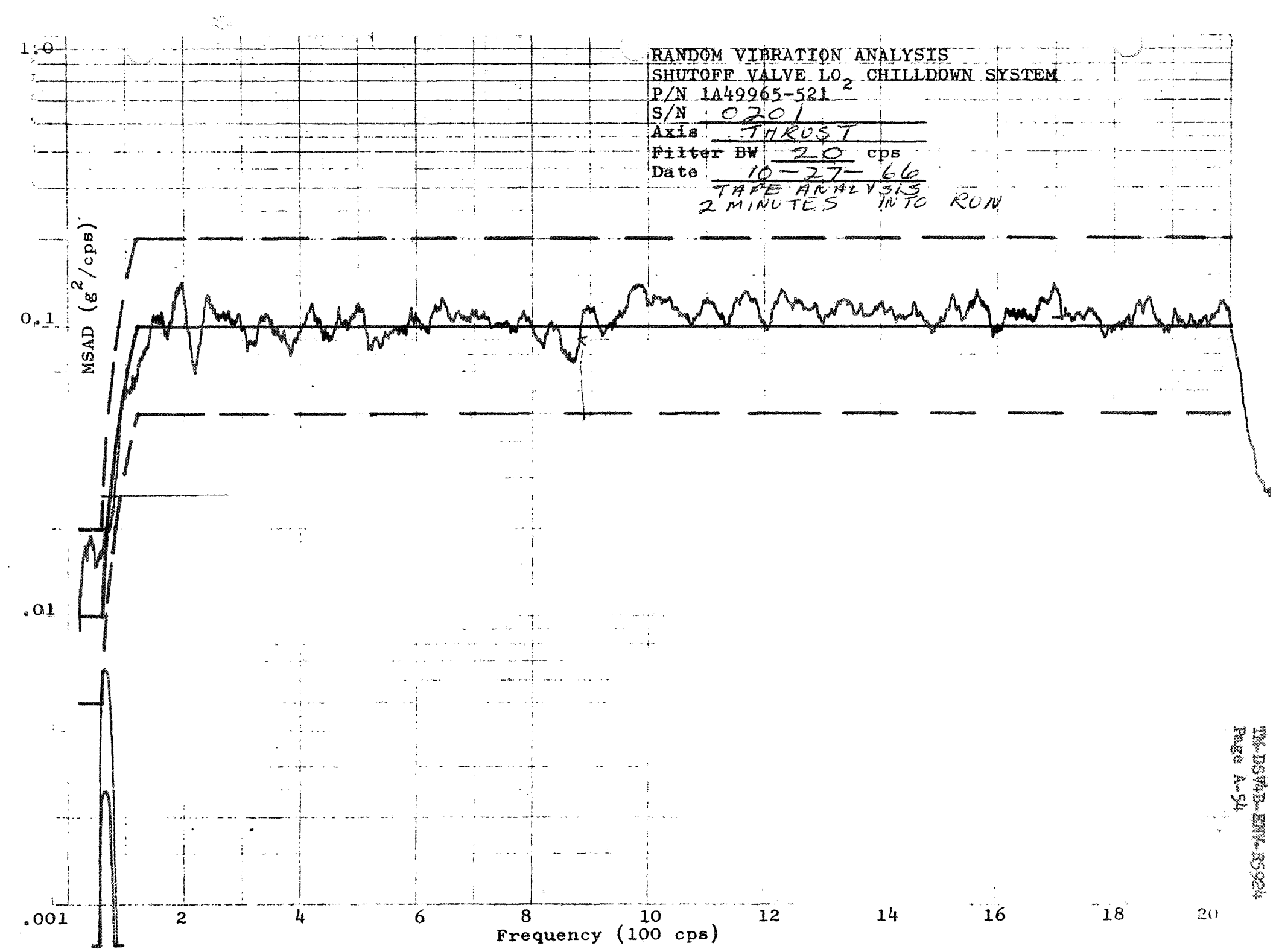
LEGEND...
UPSWEEP ———
DOWNSWEEP ------

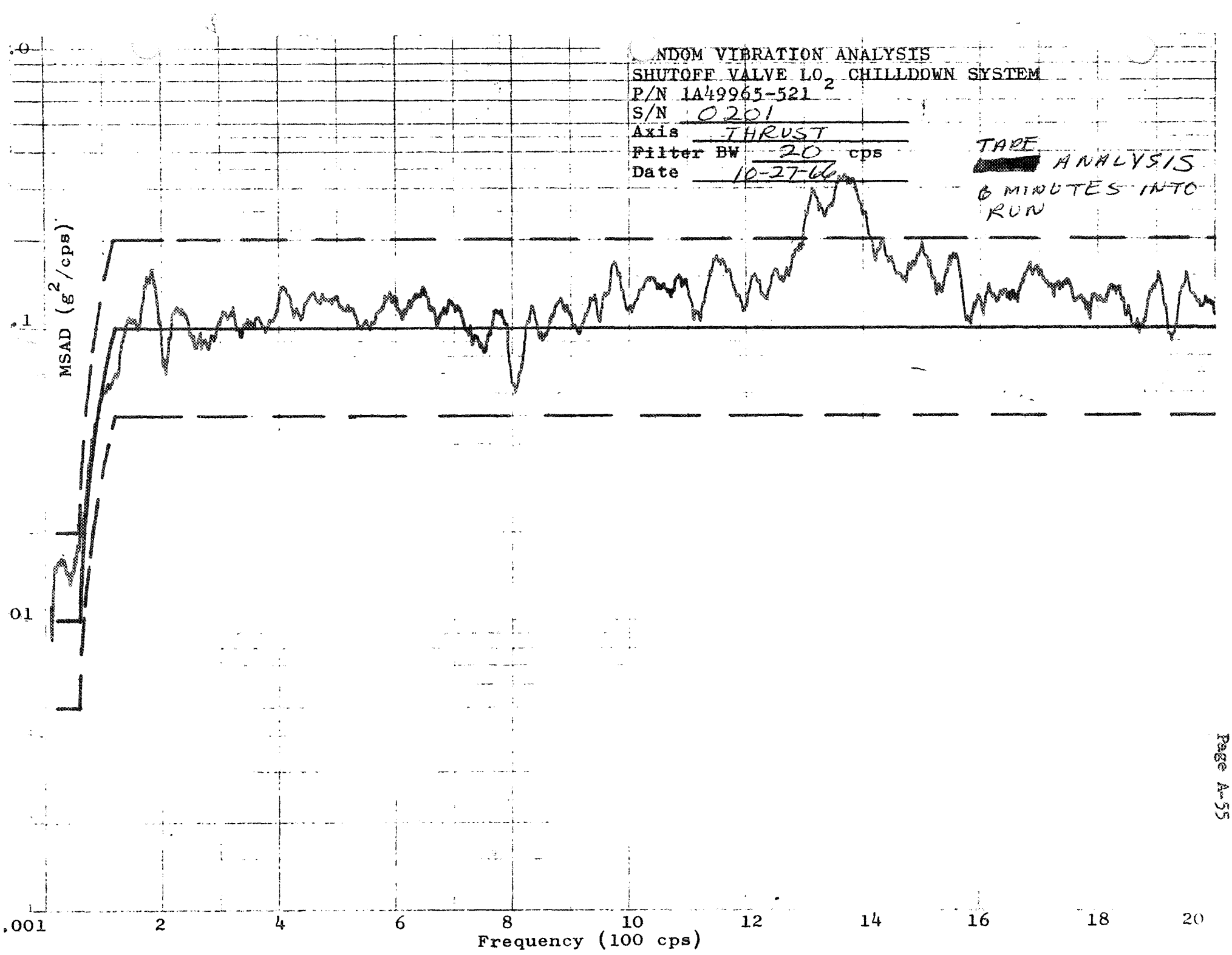
TEST CONDITIONS....
TEST DATE..... 10/25/66
AXIS OF EXCITATION.... THRUST
PICK UP NUMBER (2)... 2 FILTERED
PICK UP RESPONSE..... THRUST
INPUT ACCEL.PER PAGE.. _____




RANDOM VIBRATION ANALYSIS
SHUTOFF VALVE LO_2 CHILLDOWN SYSTEM F-14A
P/N 1A49965-521
S/N 0201
Axis Thrust
Filter BW cps
Date 10-26-66
Full Power Level
Analysis
Stop AT 15
MSAD (g^2/cps)
1.0
0.1
.01
.001
2
4
6
8
10
12
14
16
18
20
Frequency (100 cps)


RANDOM VIBRATION ANALYSIS
SHUTOFF VALVE LO2 CHILLDOWN SYSTEM
P/N 1A49965-521
S/N C201
Axis THRUST
Filter BW 20 cps
Date 11-27-66
LIVE RUN
1.0
0.1
.01
.001
MSAD (g²/cps)
2
4
6
8
10
12
14
16
18
20
Frequency (100 cps)


RANDOM VIBRATION ANALYSIS
SHUTOFF VALVE LO2 CHILLDOWN SYSTEM
P/N 1A49965-521
S/N 0201
Axis THRUST
Filter BW 20 cps
Date 10-27-66
TAPE ANALYSIS
2 MINUTES INTO RUN
1.0
0.1
.01
.001
MSAD (g²/cps)
2
4
6
8
10
12
14
16
18
20
Frequency (100 cps)


RANDOM VIBRATION ANALYSIS
SHUTOFF VALVE LO2 CHILLDOWN SYSTEM
P/N 1A49965-521
S/N 0201
Axis THRUST
Filter BW 20 cps
Date 10-27-66
TARE ANALYSIS
6 MINUTES INTO RUN
MSAD (g²/cps)
1.0
.1
.01
.001
2
4
6
8
10
12
14
16
18
20
Frequency (100 cps)

DSV-4B RANDOM VIBRATION TEST

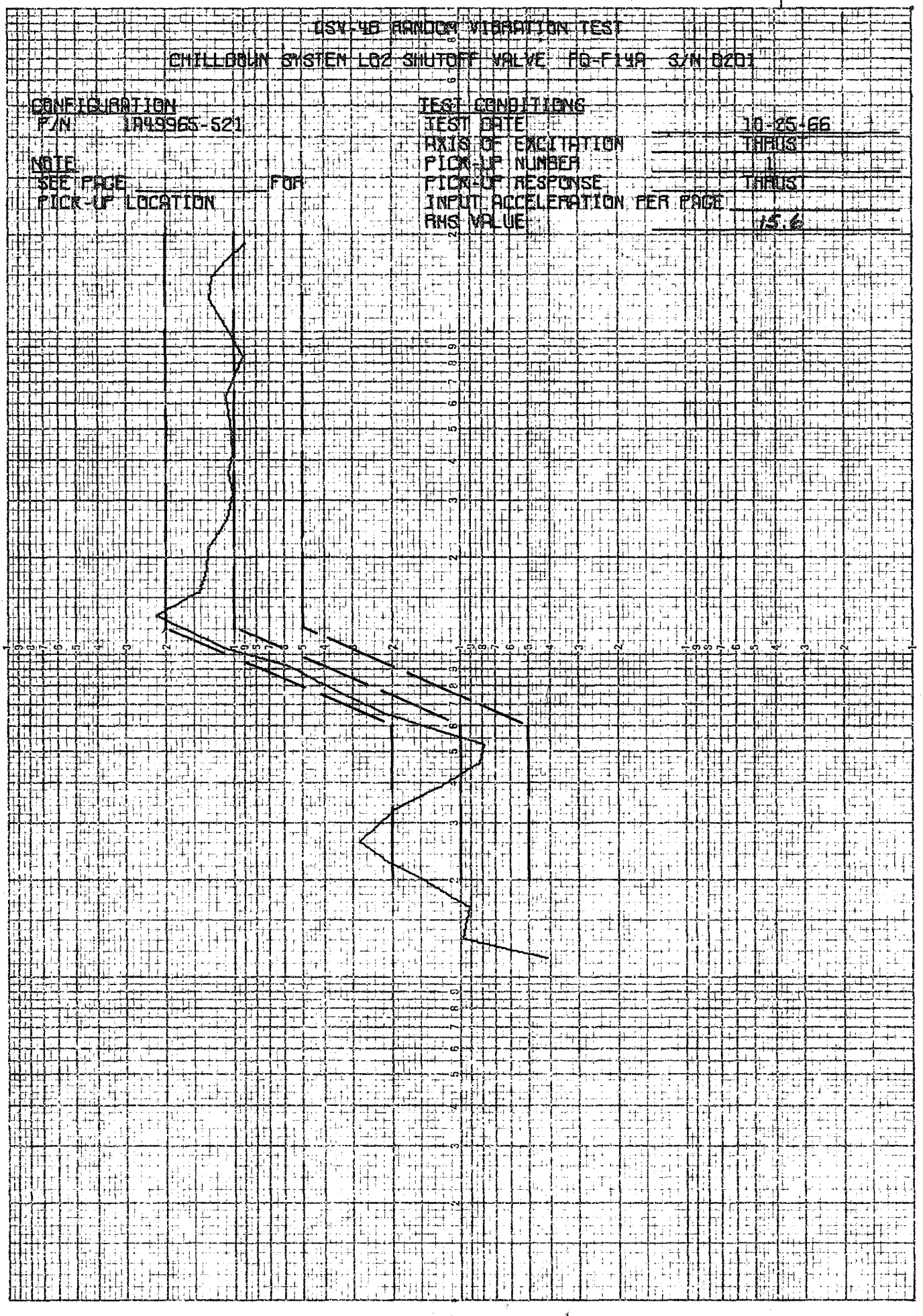
CHILLDOWN SYSTEM LO2 SHUTOFF VALVE FQ-F14A S/N 0201

CONFIGURATION
P/N 1A49965-521

NOTE
SEE PAGE FOR
PICK-UP LOCATION

TEST CONDITIONS

TEST DATE	10-25-66
AXIS OF EXCITATION	THRUST
PICK-UP NUMBER	1
PICK-UP RESPONSE	THRUST
INPUT ACCELERATION PER PAGE RMS VALUE	15.6



FORM 25-S-1
(REV. 8-53)

PREPARED BY: W. SLACK
CHECKED BY:
DATE: 10-29-66
TITLE: CHILLDOWN SHUTOFF VALVE TEST (F-1+A)

DOUGLAS AIRCRAFT COMPANY, INC.

MISSILE & SPACE SYSTEMS DIVISION

MODEL: DSV-4B
REPORT NO.: R5924

SHOCK PULSE

A AXIS

5769-6404
27903
1T07782

NOTE:
THIS DATA HAS BEEN MISPLACED
BY THE VENDOR AND IS NOT
AVAILABLE.

FORMAL QUALIFICATION TEST DATA SHEET

Item Name: LO_2 Chilldown System Shutoff Valve

Part Number: 1A49965-521

Test Procedure Drawing No.: 1T07783 Change Letter: C

Manufacturer's S/N: 0201 Test Plan Line Item: FQ-F-14A

Test Laboratory: Beech Aircraft Location: Boulder, Colorado

Douglas Test Representative: K. C. Tolides Date 10-28-66

Test Witness: _____ _____
Douglas Q.C. Customer Q.C.

Vibration Test Per Paragraph: 5.15

Test Specimen No.: 1

	Sine	Random
Test Start (Date, Time):	10-28-66 @ 0300	10-29-66 @ 0430
Test Completed (Date, Time):	10-29-66, @ 0350	10-29-66 @ 0500

Ambient Room Conditions:

Temperature °F	RH %	Atm. Press. In Hg Abs.
70	44	628 mm

Sinusoidal Sweep Test Axis Orientation: RADIAL "B"

	Sweep Rate Octave/Minute	Frequency cps	Amplitude
Required	1.0	5 to 24	0.032 In. D.A.
Actual	NOTE: Sweep Rates Approx. 1.0 Oct/Min.	5 TO 24	0.032 IN. D.A.
Required		24 to 47	1.0 G Peak
Actual		24 TO 47	1.0 G PEAK
Required		47 to 200	0.0088 In. D.A.
Actual		47 TO 200	0.0088 IN. D.A.
Required	Total Run Time	200 to 2000	17.5 G Peak
Actual	17 Min. 55 Sec.	200 TO 2000	17.5 G PEAK

Sheet ___ Of ___

FORMAL QUALIFICATION TEST DATA SHEET

Vibration Test Per Paragraph: 5.15 Test Plan Line Item: FQ-E-14A

Axis Orientation: RADIAL "B" P/N: 1A49965-521

Random Vibration Test Specimen No.: 1 S/N: 0201 Date: 10-29-66

	Time Applied (Minutes)	Frequency cps	Amplitude
Required	12	20 to 60	$0.01G^2$/cps
Actual	12	*	*
Required	12	60 to 120	+10db/Octave
Actual	12	*	*
Required	12	120 to 2000	$0.1G^2$/cps
Actual	12	*	*

Accept: X Reject:

Comment:

* See Attached Plots

Mechanical Shock Test Per Paragraph: 5.16

Test Start (Date, Time): 10-29-66, @ 0530

Test Completed (Date, Time): 10-29-66, @ 1145

Test Parameter	Units	Required	Actual
Amplitude (1/2 Sine Pulse)	G	20 Peak	20 PEAK
Time	milliseconds	10(±2)	10 (±2)
Amplitude (1/2 Sine Pulse)	G	20 Peak	20 PEAK
Time	milliseconds	10(±2)	10 (±2)
Amplitude (1/2 Sine Pulse)	G	20 Peak	20 PEAK
Time	milliseconds	10(±2)	10 (±2)

DOUGLAS AIRCRAFT COMPANY , INC.

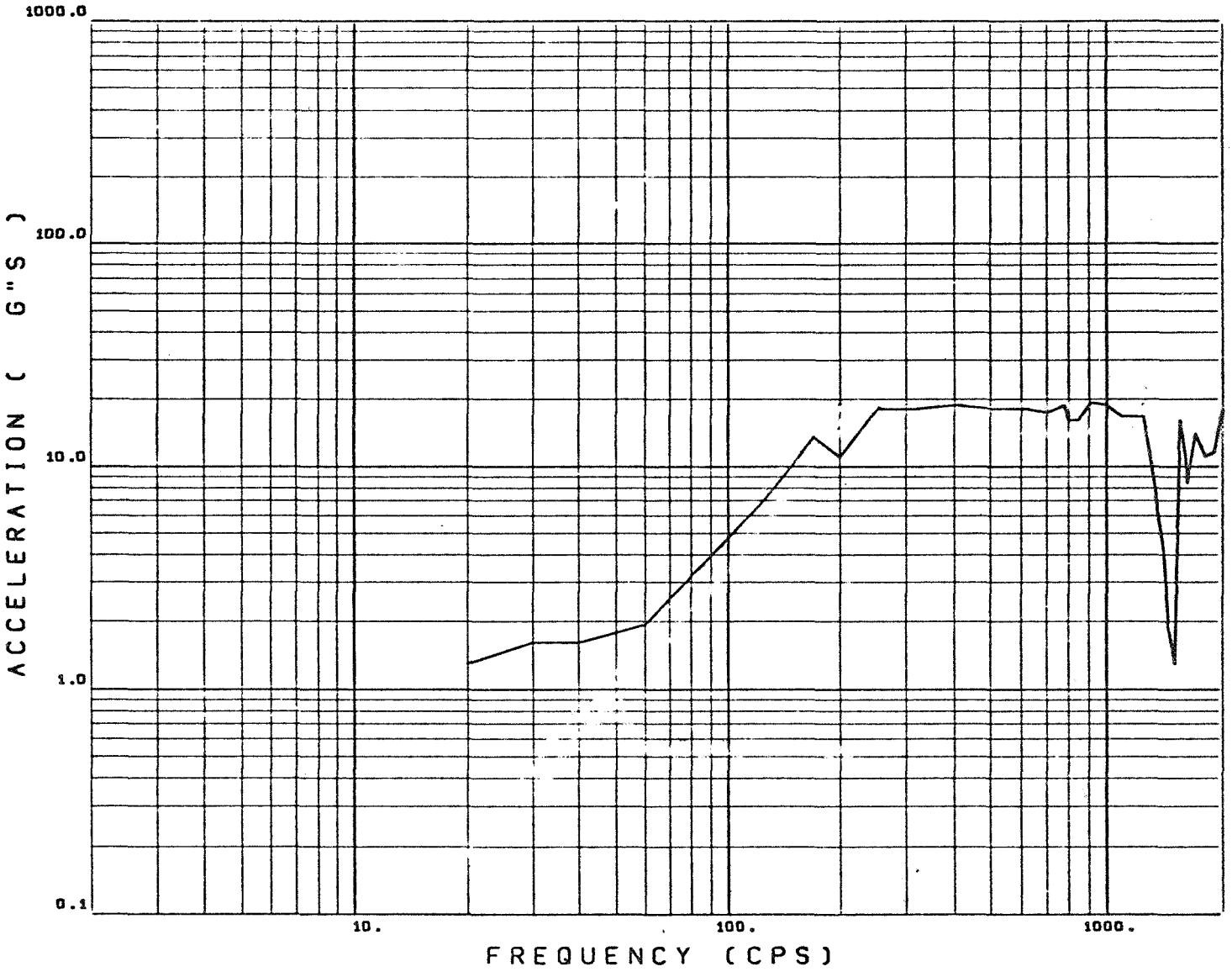
PAGE NO. _____
REPORT NO. _____

SINUSOIDAL FREQUENCY SWEEP
SIV-B CHILLDOWN SHUTOFF VALVE
(FQ F-14A)

CONFIGURATION --- S/N 0201
NOTE... SEE PAGE _____
FOR PICK UP LOCATION

LEGEND...
UPSWEEP _____
DOWNSWEEP ------

TEST CONDITIONS....
TEST DATE..... 10/29/66
AXIS OF EXCITATION.... RADIAL
PICK UP NUMBER (1)... 1 FILTERED
PICK UP RESPONSE..... RADIAL
INPUT ACCEL.PER PAGE.. _____



DOUGLAS AIRCRAFT COMPANY , INC.

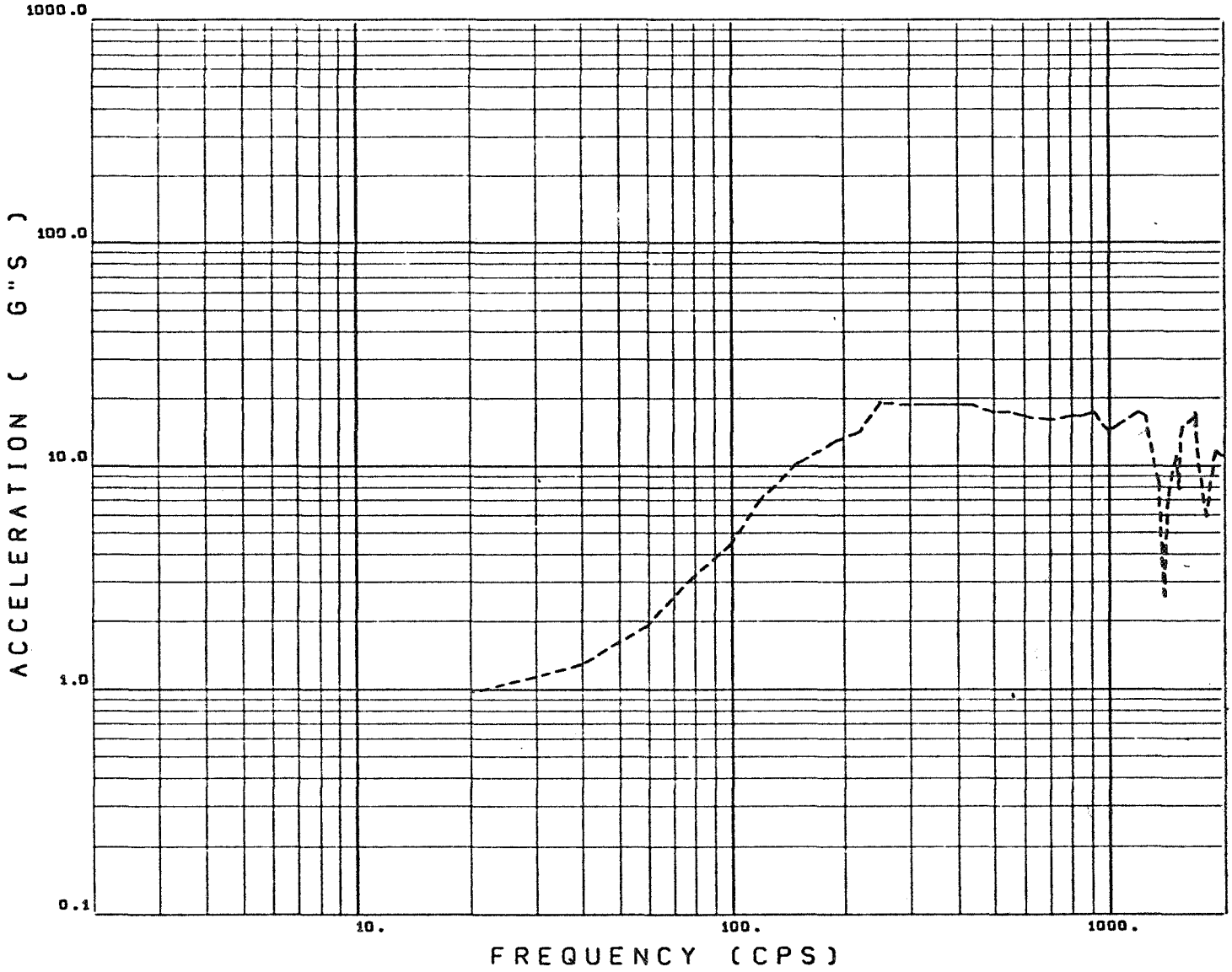
PAGE NO. _____
REPORT NO. _____

SINUSOIDAL FREQUENCY SWEEP
SIV-B CHILLDOWN SHUTOFF VALVE
(FQ F-14A)

CONFIGURATION --- S/N 0201
NOTE... SEE PAGE _____
FOR PICK UP LOCATION

LEGEND...
UPSWEEP ———
DOWNSWEEP ------

TEST CONDITIONS....
TEST DATE..... 10/29/66
AXIS OF EXCITATION.... RADIAL
PICK UP NUMBER (1) ... 1 FILTERED
PICK UP RESPONSE..... RADIAL
INPUT ACCEL.PER PAGE.. _____



DOUGLAS AIRCRAFT COMPANY , INC.

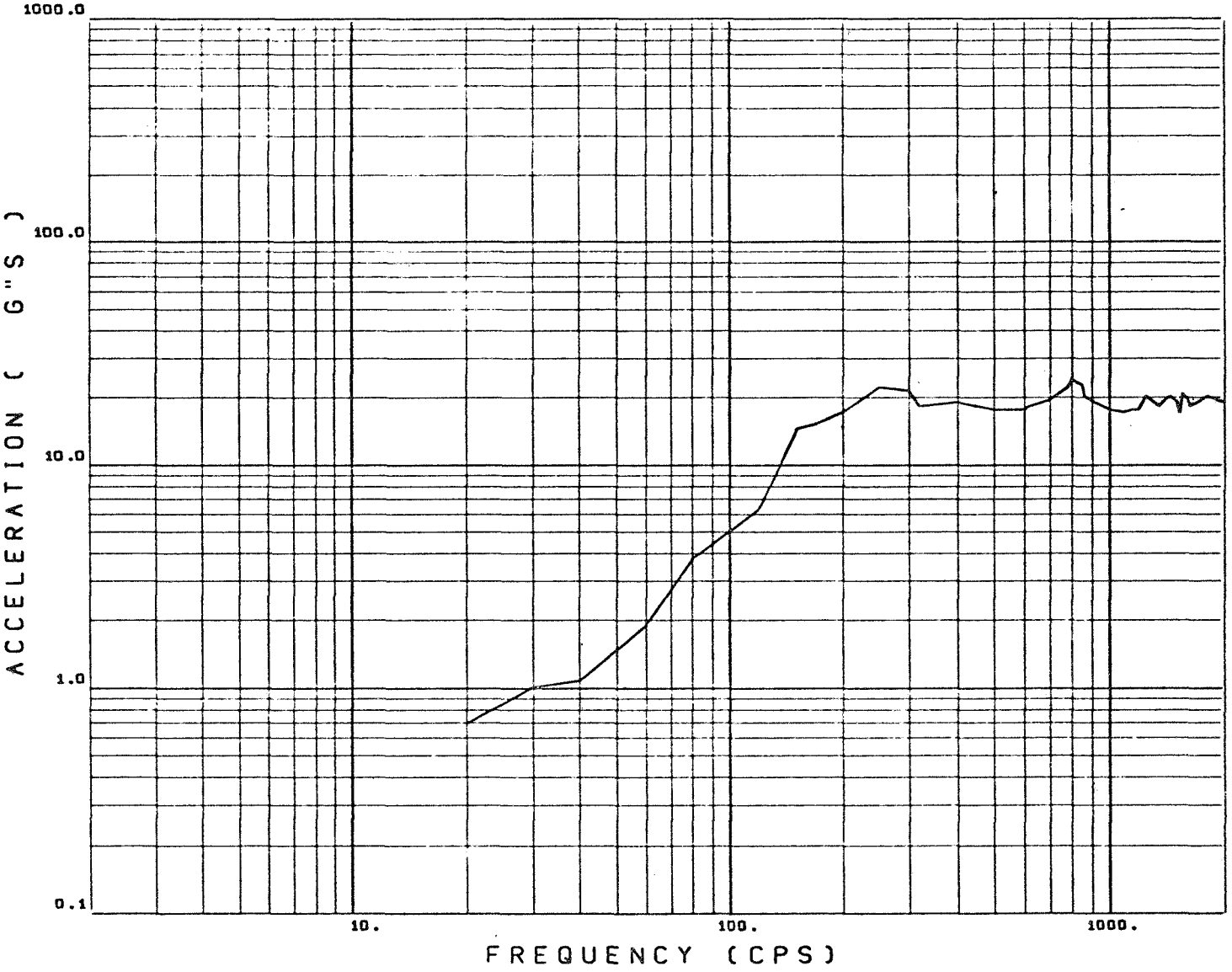
PAGE NO. _____
REPORT NO. _____

SINUSOIDAL FREQUENCY SWEEP
SIV-B CHILLDOWN SHUTOFF VALVE
(FQ F-14A)

CONFIGURATION --- S/N 0201
NOTE... SEE PAGE _____
FOR PICK UP LOCATION

LEGEND...
UPSWEEP ———
DOWNSWEEP ------

TEST CONDITIONS....
TEST DATE..... 10/29/66
AXIS OF EXCITATION.... RADIAL
PICK UP NUMBER (1)... 1 UNFILTERED
PICK UP RESPONSE..... RADIAL
INPUT ACCEL.PER PAGE.. _____



DOUGLAS AIRCRAFT COMPANY , INC.

PAGE NO. _____
REPORT NO. _____

SINUSOIDAL FREQUENCY SWEEP

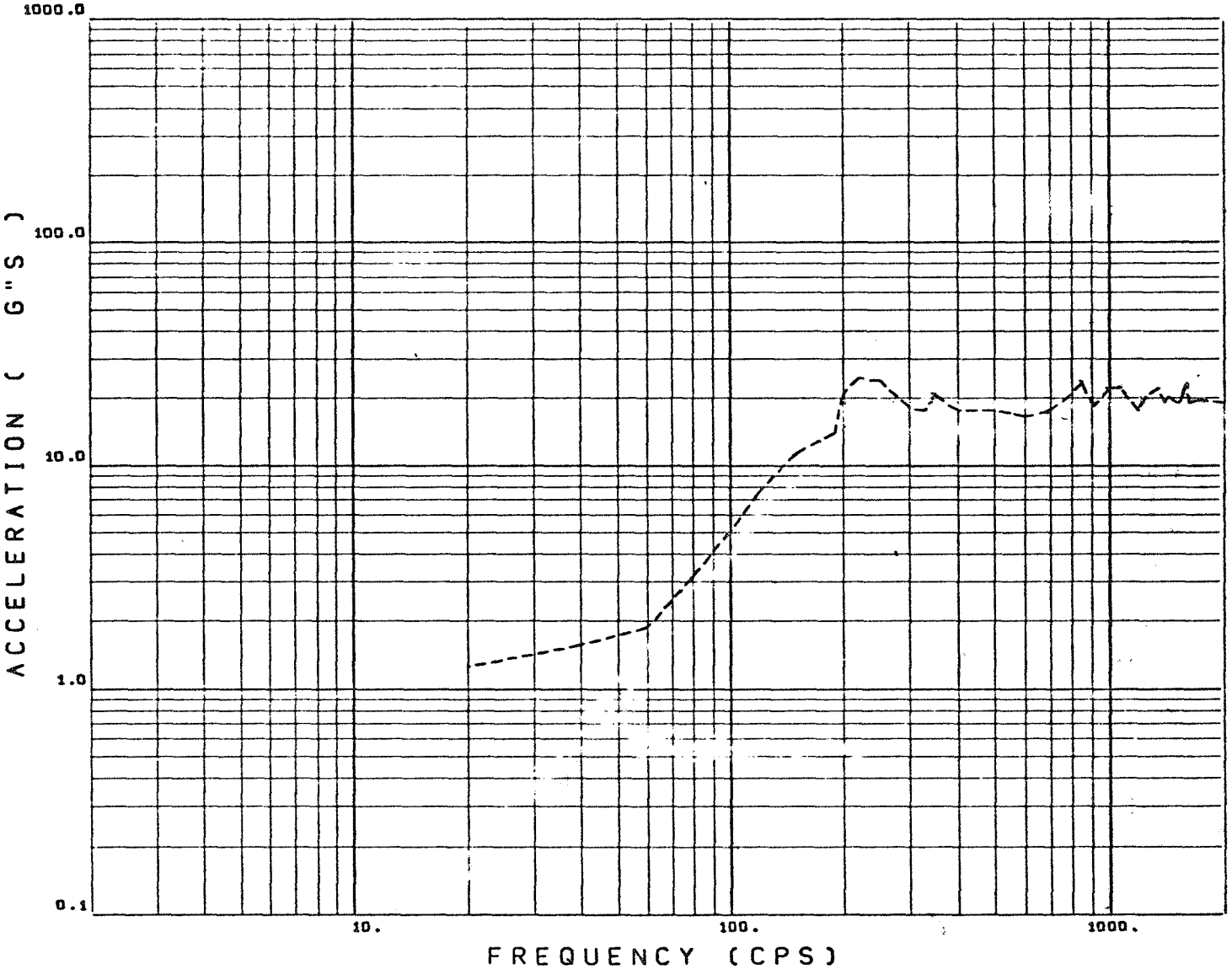
SIV-B CHILLDOWN SHUTOFF VALVE

(FQ F-14A)

CONFIGURATION --- S/N 0201
NOTE... SEE PAGE _____
FOR PICK UP LOCATION

LEGEND...
UPSWEEP ———
DOWNSWEEP ------

TEST CONDITIONS....
TEST DATE..... 10/29/66
AXIS OF EXCITATION.... RADIAL
PICK UP NUMBER (1)... 1 UNFILTERED
PICK UP RESPONSE..... RADIAL
INPUT ACCEL.PER PAGE.. _____



DOUGLAS AIRCRAFT COMPANY , INC.

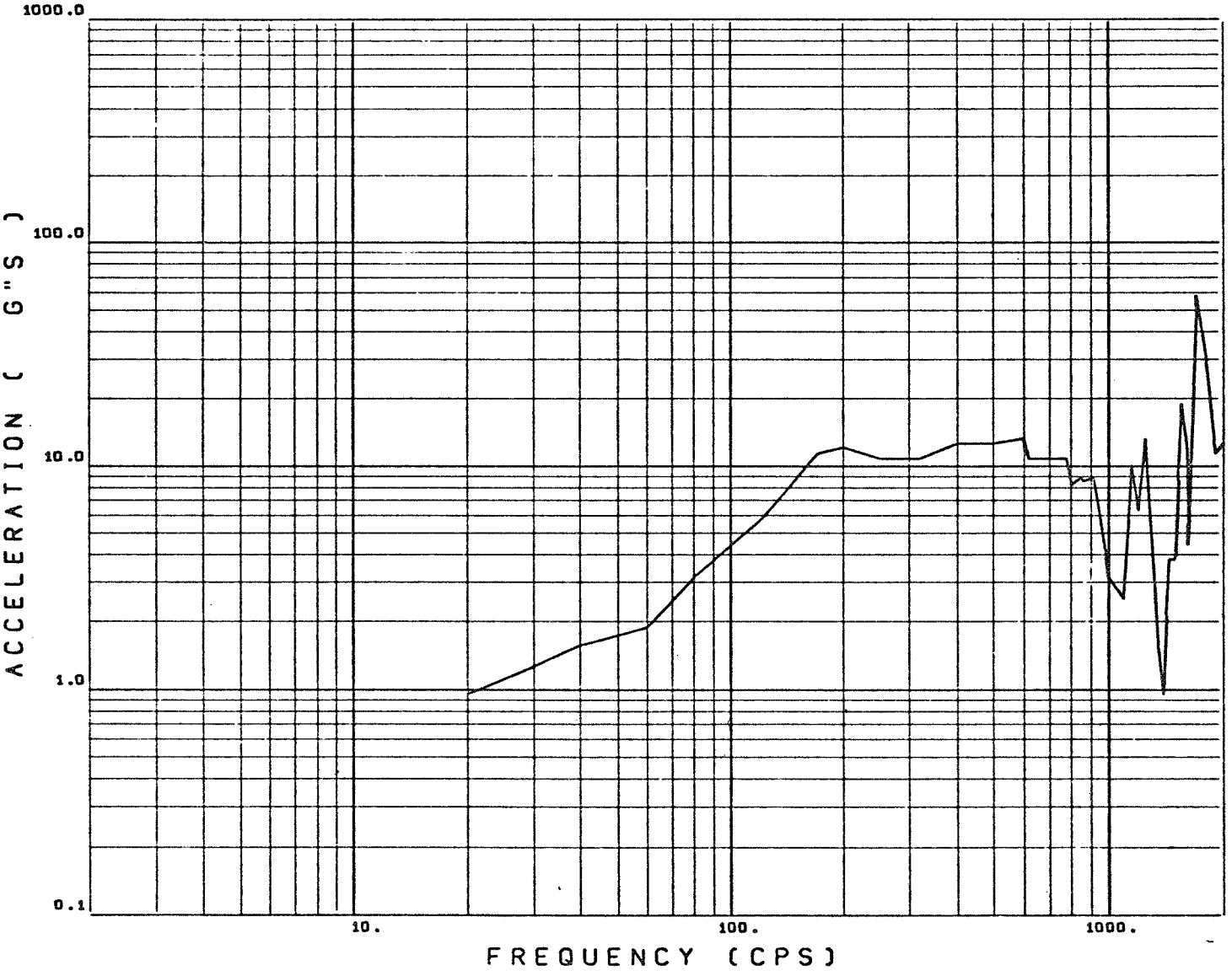
PAGE NO. _____
REPORT NO. _____

SINUSOIDAL FREQUENCY SWEEP
SIV-B CHILLDOWN SHUTOFF VALVE
(FQ F-14A)

CONFIGURATION --- S/N 0201
NOTE... SEE PAGE _____
FOR PICK UP LOCATION

LEGEND...
UPSWEEP ——
DOWNSWEEP ------

TEST CONDITIONS....
TEST DATE..... 10/29/66
AXIS OF EXCITATION.... RADIAL
PICK UP NUMBER (2)... 2 FILTERED
PICK UP RESPONSE..... RADIAL
INPUT ACCEL.PER PAGE.. _____



DOUGLAS AIRCRAFT COMPANY , INC.

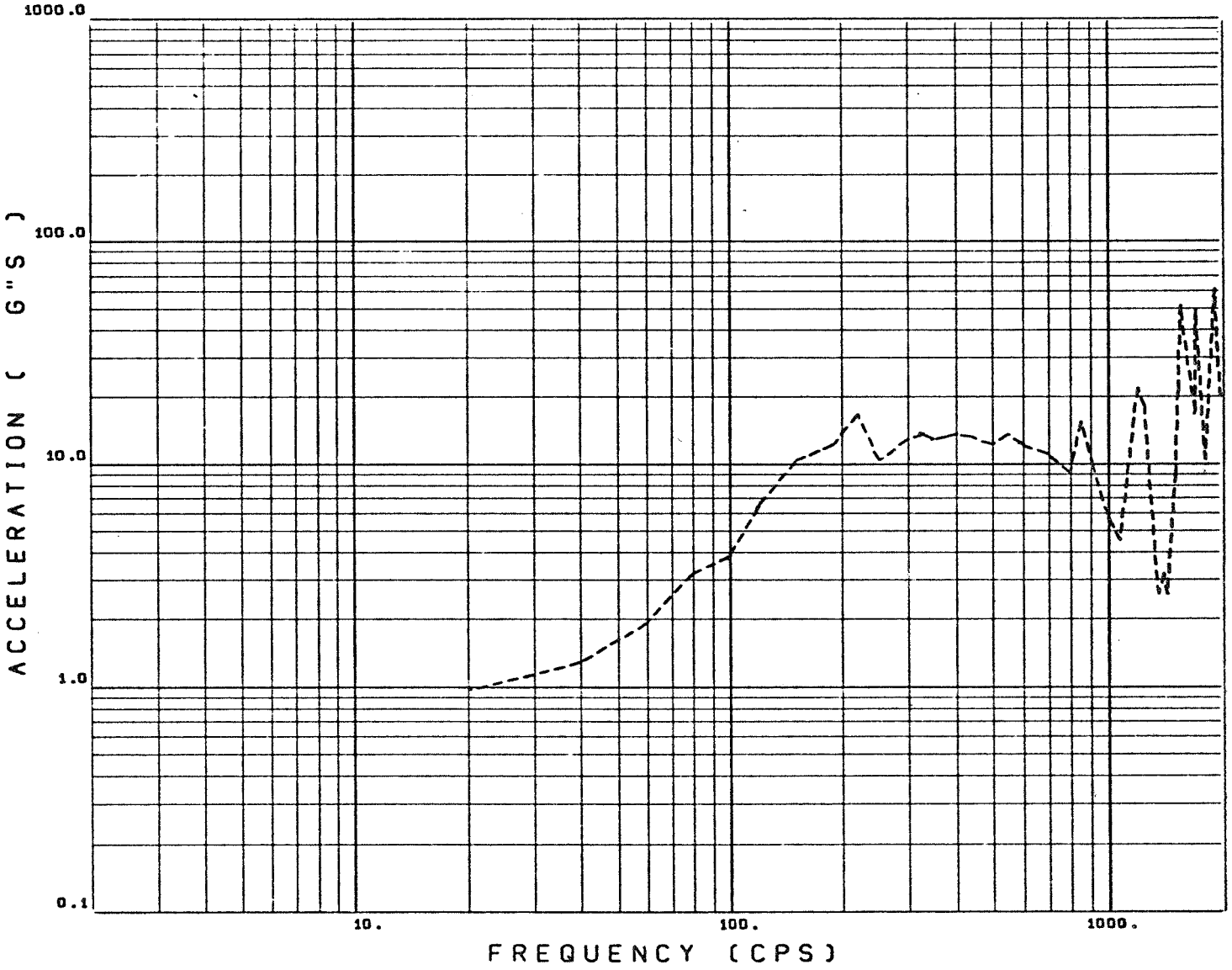
PAGE NO. _____
REPORT NO. _____

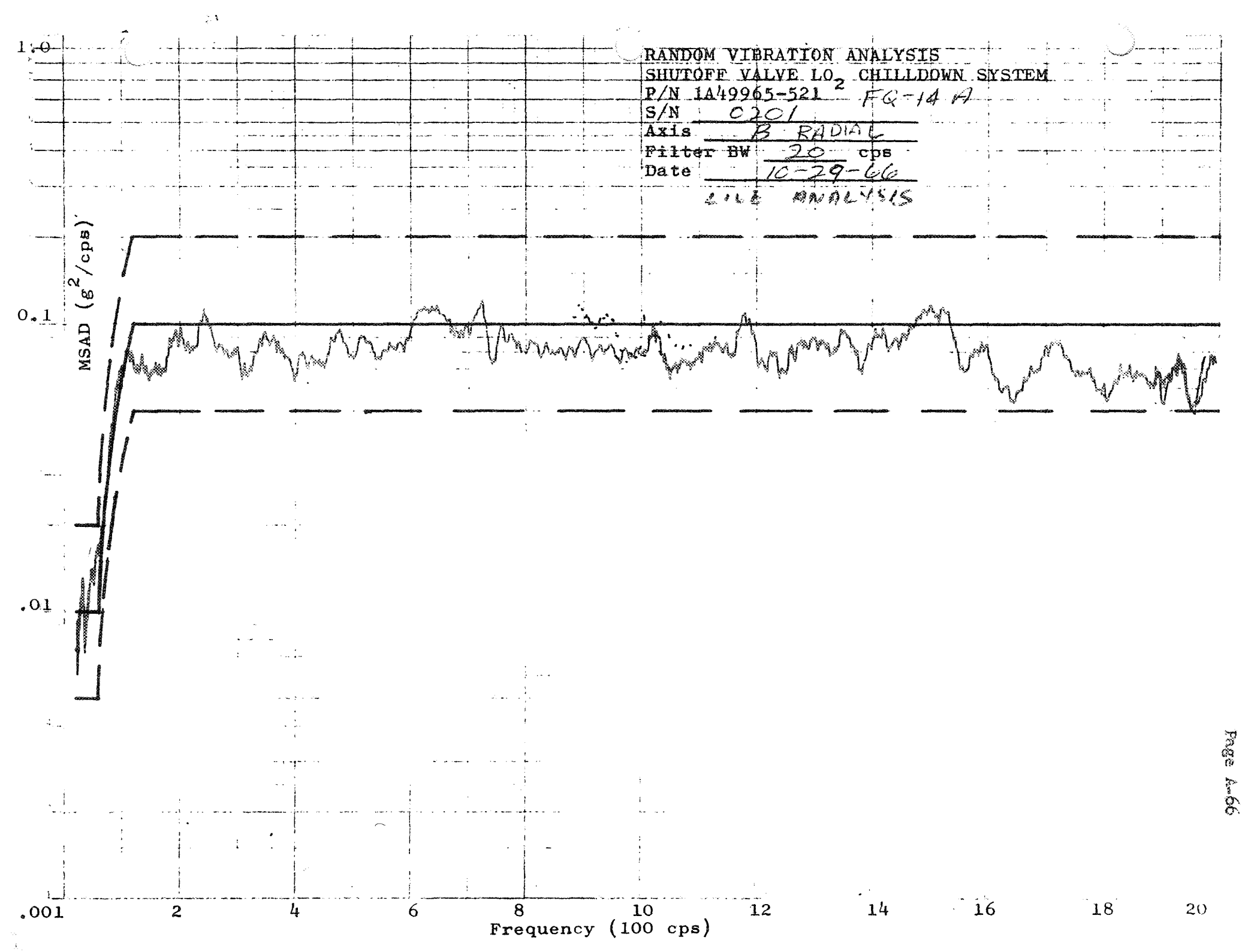
SINUSOIDAL FREQUENCY SWEEP
SIV-B CHILLDOWN SHUTOFF VALVE
(FQ F-14A)

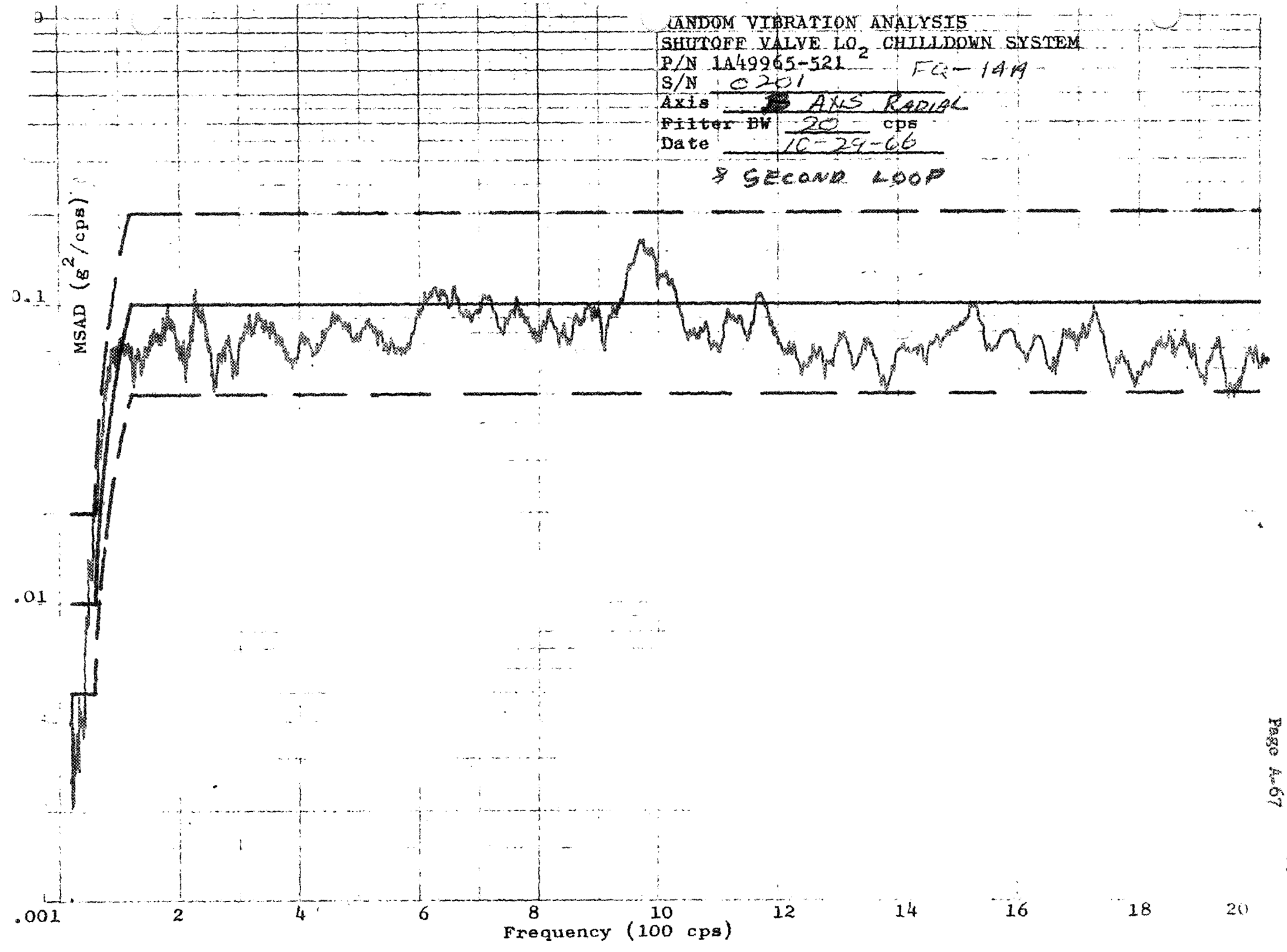
CONFIGURATION --- S/N 0201
NOTE... SEE PAGE _____
FOR PICK UP LOCATION

LEGEND...
UPSWEEP ———
DOWNSWEEP ------

TEST CONDITIONS....
TEST DATE..... 10/29/66
AXIS OF EXCITATION.... RADIAL
PICK UP NUMBER (2)... 2 FILTERED
PICK UP RESPONSE..... RADIAL
INPUT ACCEL.PER PAGE.. _____




RANDOM VIBRATION ANALYSIS
SHUTOFF VALVE LO2 CHILLDOWN SYSTEM
P/N 1A49965-521 FQ-14 A
S/N 0201
Axis B RADIAL
Filter BW 20 cps
Date 10-29-66
2.1 ANALYSIS
1.0
0.1
.01
.001
MSAD (g2/cps)
2
4
6
8
10
12
14
16
18
20
Frequency (100 cps)


RANDOM VIBRATION ANALYSIS
SHUTOFF VALVE LO2 CHILLDOWN SYSTEM
P/N 1A49965-521 FQ-149
S/N C201
Axis B AXIS RADIAL
Filter BW 20 cps
Date 10-29-66
9 SECOND LOOP
MSAD (g2/cps)
0.1
.01
.001
2
4
6
8
10
12
14
16
18
20
Frequency (100 cps)

RANDOM VIBRATION TEST

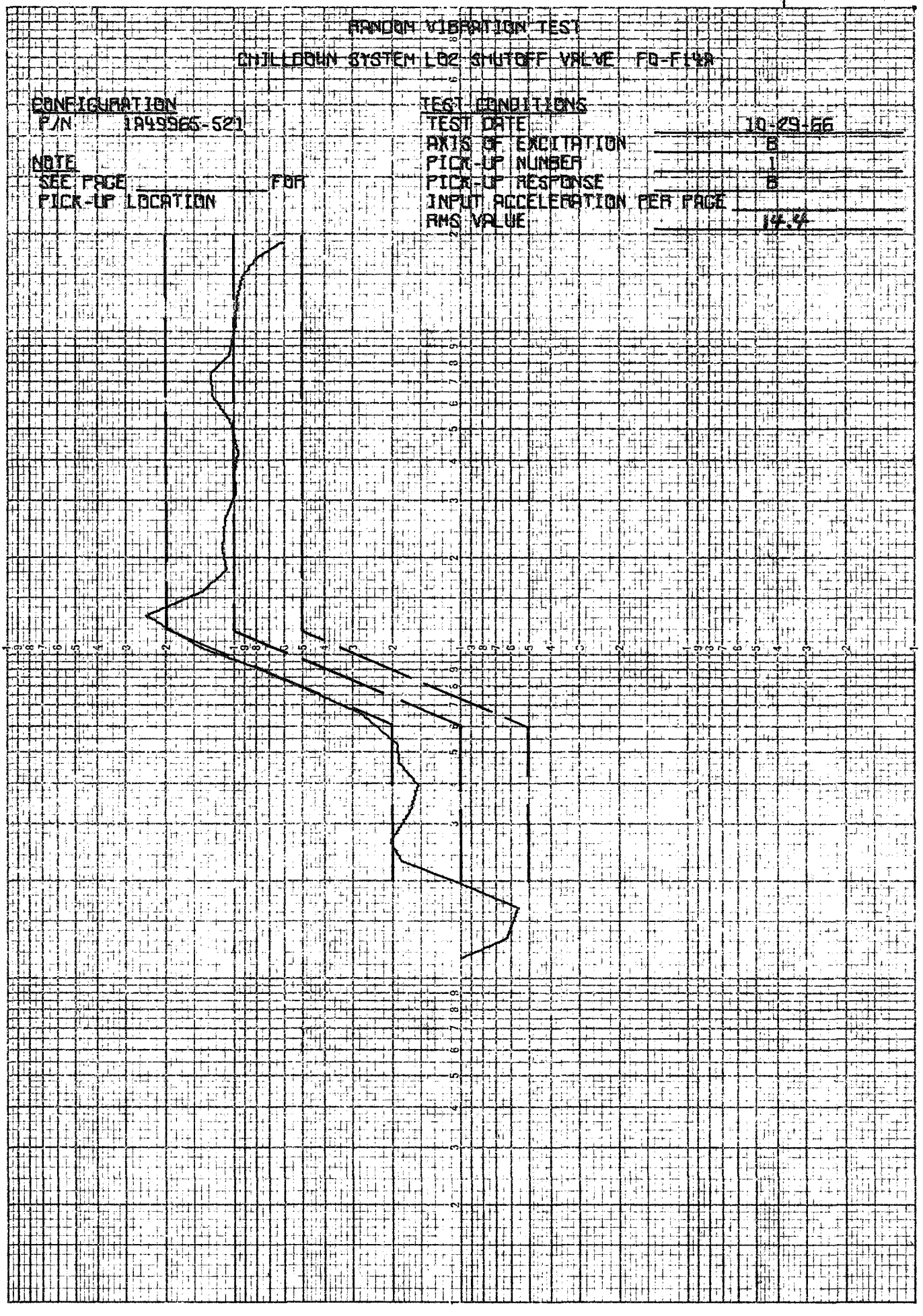
CHILLDOWN SYSTEM LO2 SHUTOFF VALVE FQ-F142

CONFIGURATION
P/N 1A49565-521

NOTE
SEE PAGE _____ FOR
PICK-UP LOCATION

TEST CONDITIONS

TEST DATE	10-29-56
AXIS OF EXCITATION	B
PICK-UP NUMBER	1
PICK-UP RESPONSE	B
INPUT ACCELERATION PER PAGE	
RMS VALUE	14.4



FORM 25-S-1
(REV. 8-53)

PREPARED BY: W. SLACK
CHECKED BY:
DATE: 10-29-66
TITLE: CHILLDOWN SHUTOFF VALVE TEST (F-14A)

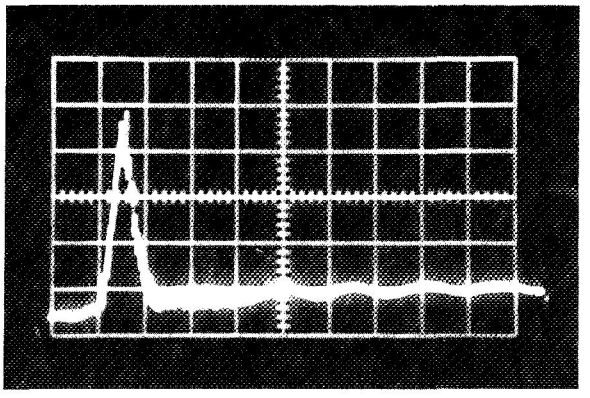
DOUGLAS AIRCRAFT COMPANY, INC.

MISSILE & SPACE SYSTEMS DIVISION

PAGE:
MODEL: DSV-4B
REPORT NO.:

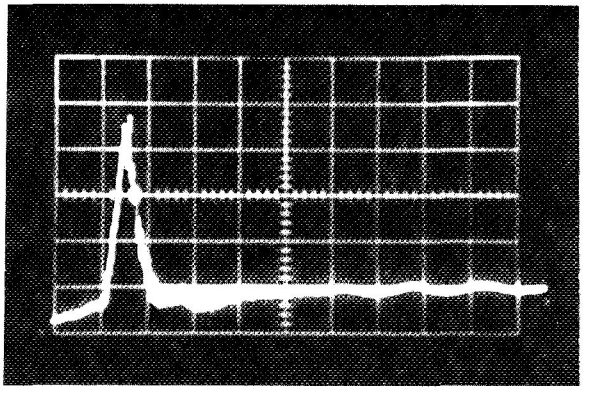
5769-6404
27903
1T07782

SHOCK PULSE
B AXIS



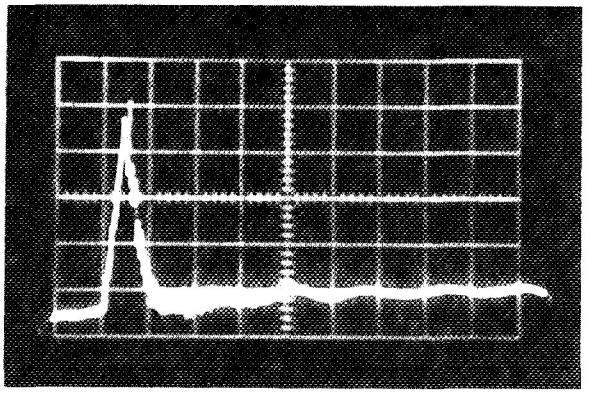
5 G's/DIVISION

10 MSEC/DIVISION



5 G's/DIVISION

10 MSEC/DIVISION



5 G's/DIVISION

10 MSEC/DIVISION

FORMAL QUALIFICATION TEST DATA SHEET

Item Name: LO_2 Chilldown System Shutoff Valve

Part Number: 1A49965-521

Test Procedure Drawing No.: 1T07783 Change Letter: C

Manufacturer's S/N: 0201 Test Plan Line Item: FQ-F-14A

Test Laboratory: Beech Aircraft Location: Boulder, Colorado

Douglas Test Representative: K. C. Tolides Date 10-29-66

Test Witness: _____ Douglas Q.C. _____ Customer Q.C.

Vibration Test Per Paragraph: 5.15

Test Specimen No.: 1

	Sine	Random
Test Start (Date, Time):	10-29-66, @ 1730	10-29-66, @ 1950
Test Completed (Date, Time):	10-29-66, @ 1815	10-29-66, @ 2030

Ambient Room Conditions:

Temperature °F	RH %	Atm. Press. In Hg Abs.
70	44	628 mm

Sinusoidal Sweep Test Axis Orientation: TANG. "C"

	Sweep Rate Octave/Minute	Frequency cps	Amplitude
Required	1.0	5 to 24	0.032 In. D.A.
Actual	NOTE: Sweep Rates Approx. 1.0 Oct/Min.	5 TO 24	0.032 IN. D.A.
Required		24 to 47	1.0 G Peak
Actual		24 TO 47	1.0 G PEAK
Required		47 to 200	0.0088 In. D.A.
Actual		47 TO 200	0.0088 IN. D.A.
Required	Total Run Time	200 to 2000	17.5 G Peak
Actual	17 Min. 35 Sec.	200 TO 2000	17.5 G PEAK

Sheet ___ Of ___

FORMAL QUALIFICATION TEST DATA SHEET

Vibration Test Per Paragraph: 5.15 Test Plan Line Item: FQ-F-14A

Axis Orientation: TANGENTIAL "C" P/N: 1A49965-521

Random Vibration Test Specimen No.: 1 S/N: 0201 Date: 10-29-66

	Time Applied (Minutes)	Frequency cps	Amplitude
Required	12	20 to 60	$0.01G^2$/cps
Actual	12	*	*
Required	12	60 to 120	+10db/Octave
Actual	12	*	*
Required	12	120 to 2000	$0.1G^2$/cps
Actual	12	*	*

Accept: X Reject:

Comment:

* See Attached Plots

Mechanical Shock Test Per Paragraph: 5.16

Test Start (Date, Time): 10-29-66, @ 2100

Test Completed (Date, Time): 10-29-66, @ 2130

Test Parameter	Units	Required	Actual
Amplitude (1/2 Sine Pulse)	G	20 Peak	20 PEAK
Time	milliseconds	10(±2)	10 (±2)
Amplitude (1/2 Sine Pulse)	G	20 Peak	20 PEAK
Time	milliseconds	10(±2)	10 (±2)
Amplitude (1/2 Sine Pulse)	G	20 Peak	20 PEAK
Time	milliseconds	10(±2)	10 (±2)

DOUGLAS AIRCRAFT COMPANY , INC.

PAGE NO. _____
REPORT NO. _____

SINUSOIDAL FREQUENCY SWEEP

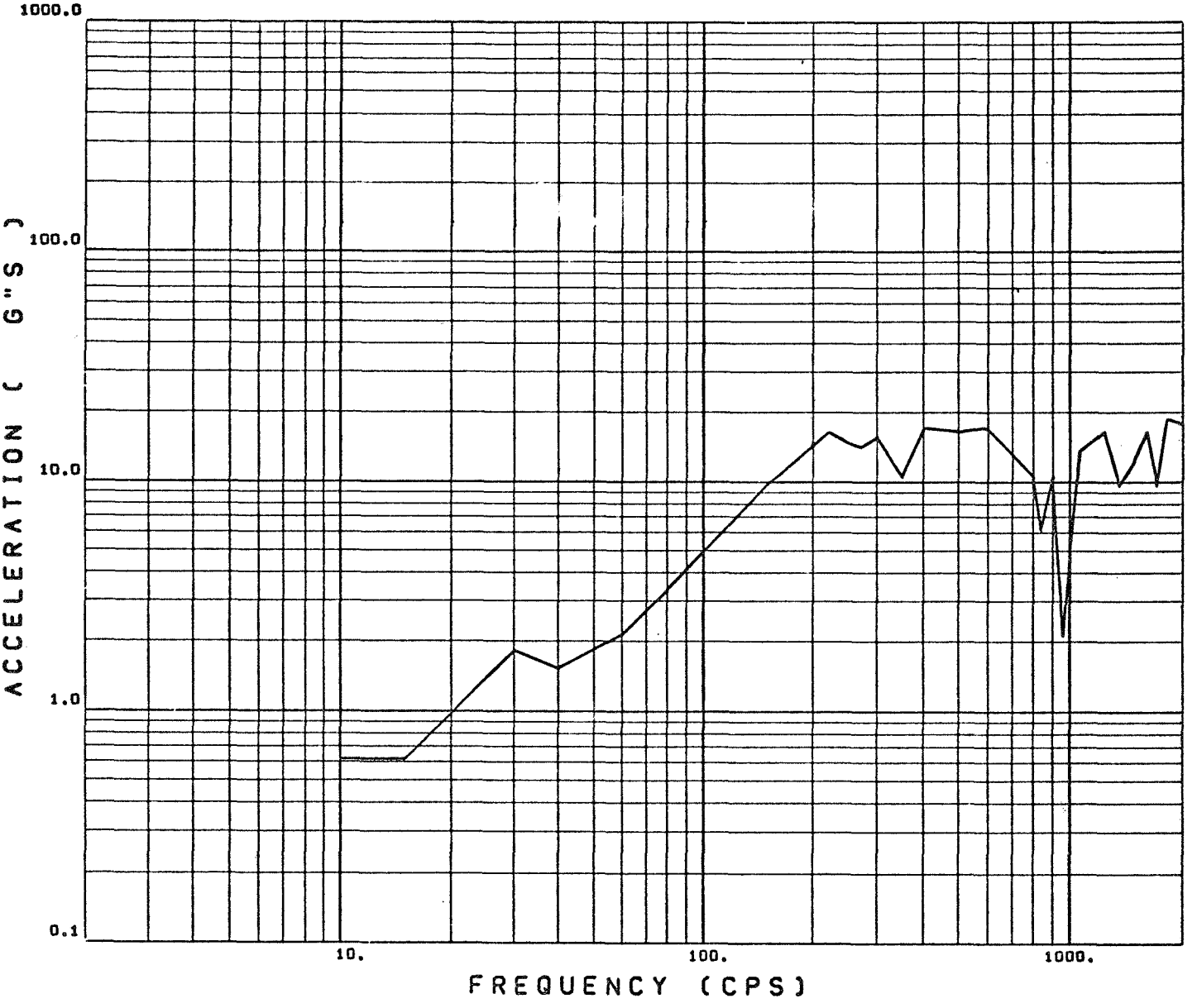
SIV-B CHILLDOWN SHUTOFF VALVE

(FQ F-14A)

CONFIGURATION --- S/N 0201
NOTE... SEE PAGE _____
FOR PICK UP LOCATION

LEGEND...
UPSWEEP ——
DOWNSWEEP ------

TEST CONDITIONS....
TEST DATE..... 10/29/66
AXIS OF EXCITATION.... TANGENTIAL
PICK UP NUMBER (1)... 1 FILTERED
PICK UP RESPONSE..... TANGENTIAL
INPUT ACCEL.PER PAGE.. _____



DOUGLAS AIRCRAFT COMPANY , INC.

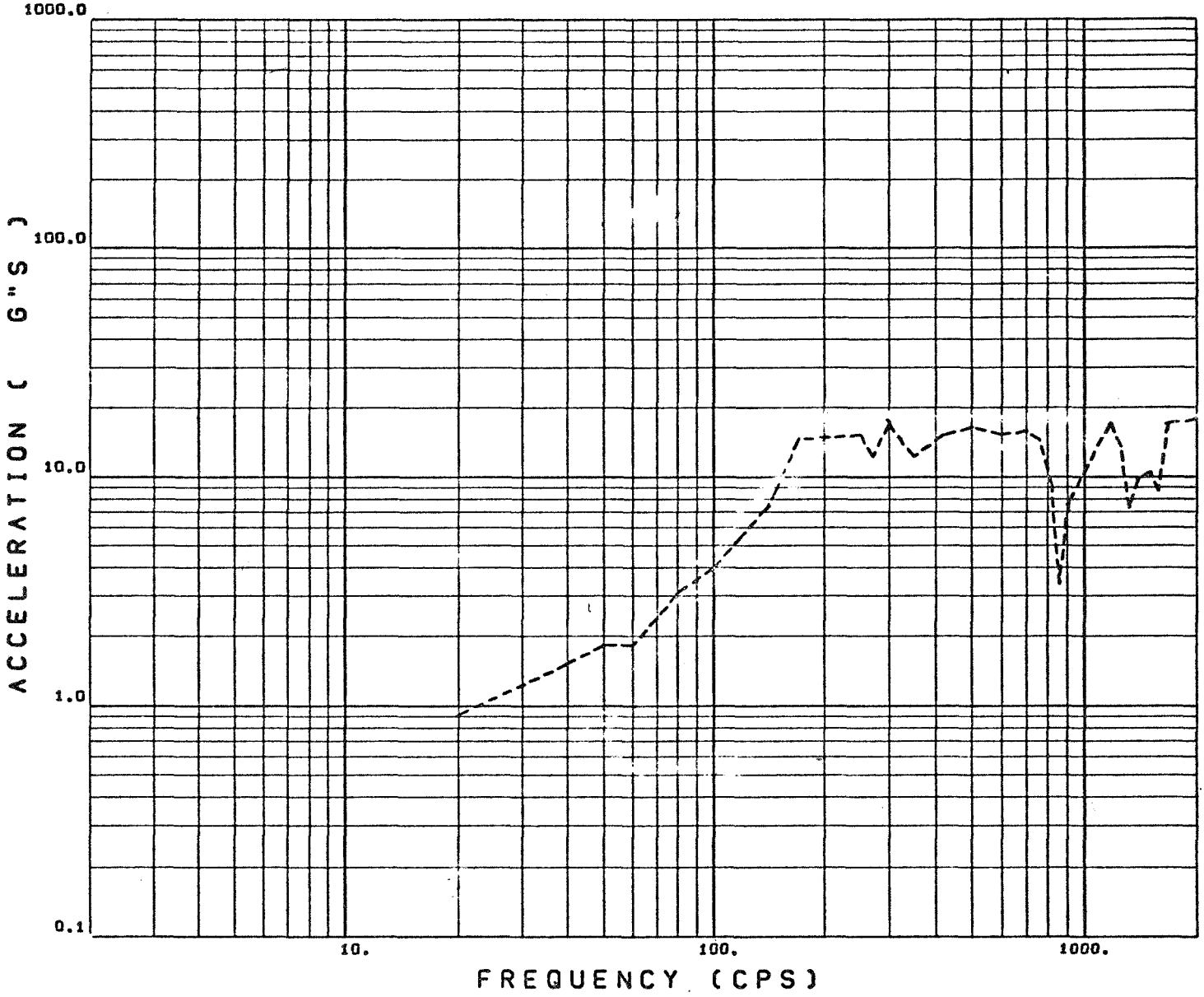
PAGE NO. _____
REPORT NO. _____

SINUSOIDAL FREQUENCY SWEEP
SIV-B CHILLDOWN SHUTOFF VALVE
(FQ F-14A)

CONFIGURATION --- S/N 0201
NOTE... SEE PAGE _____
FOR PICK UP LOCATION

LEGEND...
UPSWEEP ——
DOWNSWEEP ------

TEST CONDITIONS....
TEST DATE..... 10/29/66
AXIS OF EXCITATION.... TANGENTIAL
PICK UP NUMBER (1)... 1 FILTERED
PICK UP RESPONSE..... TANGENTIAL
INPUT ACCEL.PER PAGE.. _____



DOUGLAS AIRCRAFT COMPANY , INC.

PAGE NO. _____
REPORT NO. _____

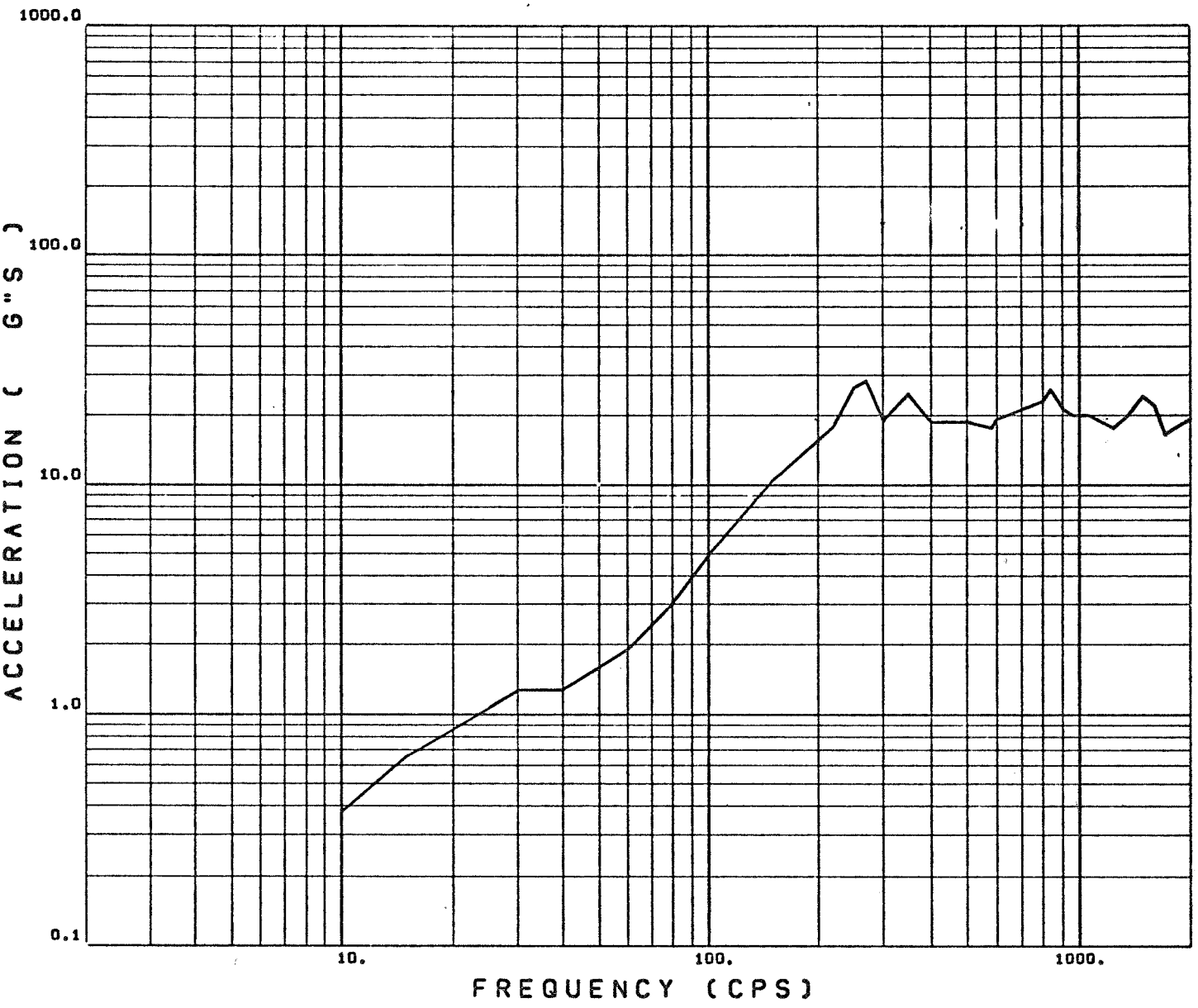
SINUSOIDAL FREQUENCY SWEEP

SIV-B CHILLDOWN SHUTOFF VALVE (FQ F-14A)

CONFIGURATION --- S/N 0201
NOTE... SEE PAGE _____
FOR PICK UP LOCATION

LEGEND...
UPSWEEP _____
DOWNSWEEP ------

TEST CONDITIONS....
TEST DATE..... 10/29/66
AXIS OF EXCITATION.... TANGENTIAL
PICK UP NUMBER (1)... 1 UNFILTERED
PICK UP RESPONSE..... TANGENTIAL
INPUT ACCEL.PER PAGE.. _____



DOUGLAS AIRCRAFT COMPANY , INC.

PAGE NO. _____
REPORT NO. _____

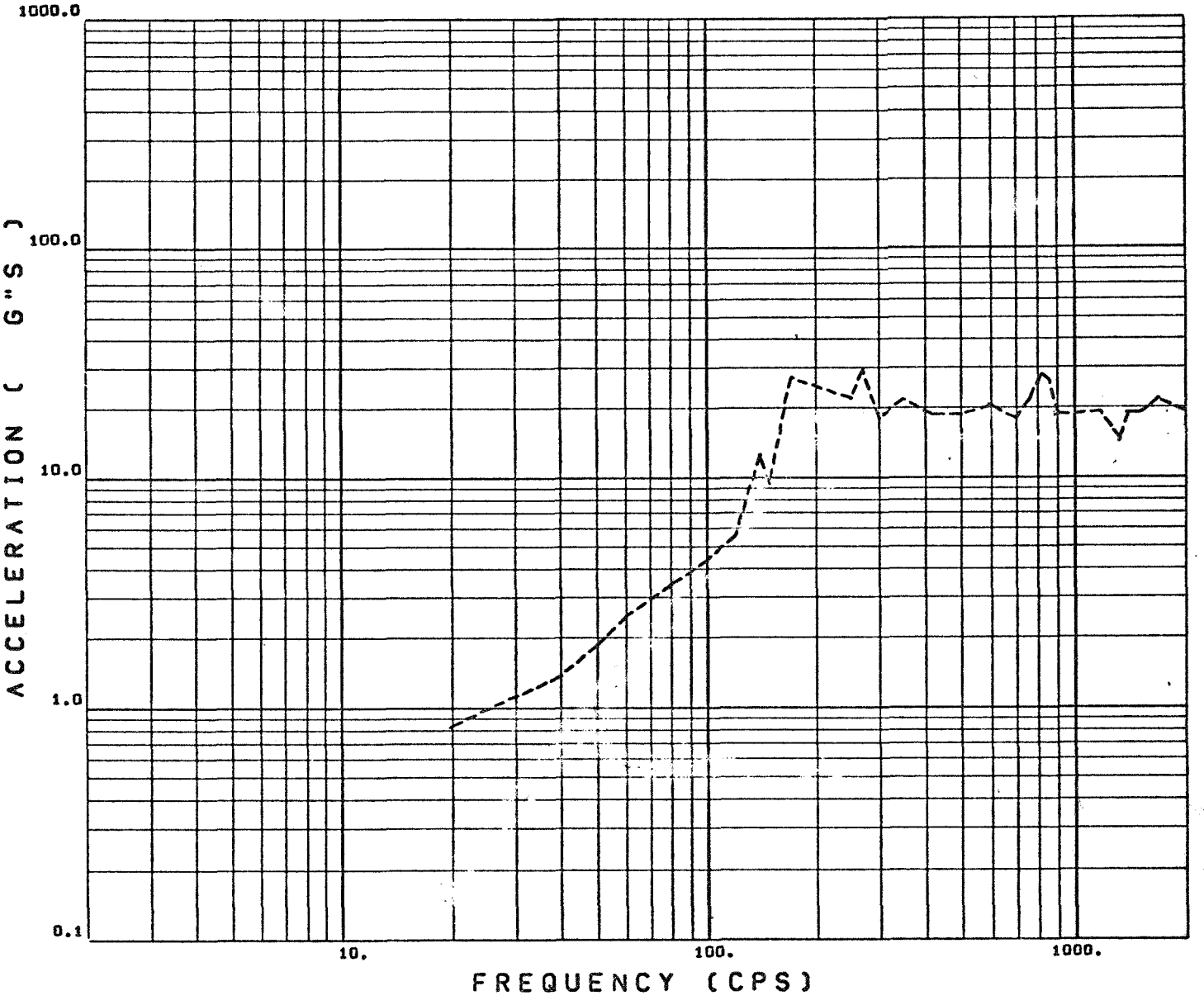
SINUSOIDAL FREQUENCY SWEEP

SIV-B CHILLDOWN SHUTOFF VALVE (FQ F-14A)

CONFIGURATION --- S/N 0201
NOTE... SEE PAGE _____
FOR PICK UP LOCATION

LEGEND...
UPSWEEP _____
DOWNSWEEP ------

TEST CONDITIONS....
TEST DATE..... 10/29/66
AXIS OF EXCITATION.... TANGENTIAL
PICK UP NUMBER (1)... 1 UNFILTERED
PICK UP RESPONSE..... TANGENTIAL
INPUT ACCEL.PER PAGE.. _____



DOUGLAS AIRCRAFT COMPANY , INC.

PAGE NO. _____
REPORT NO. _____

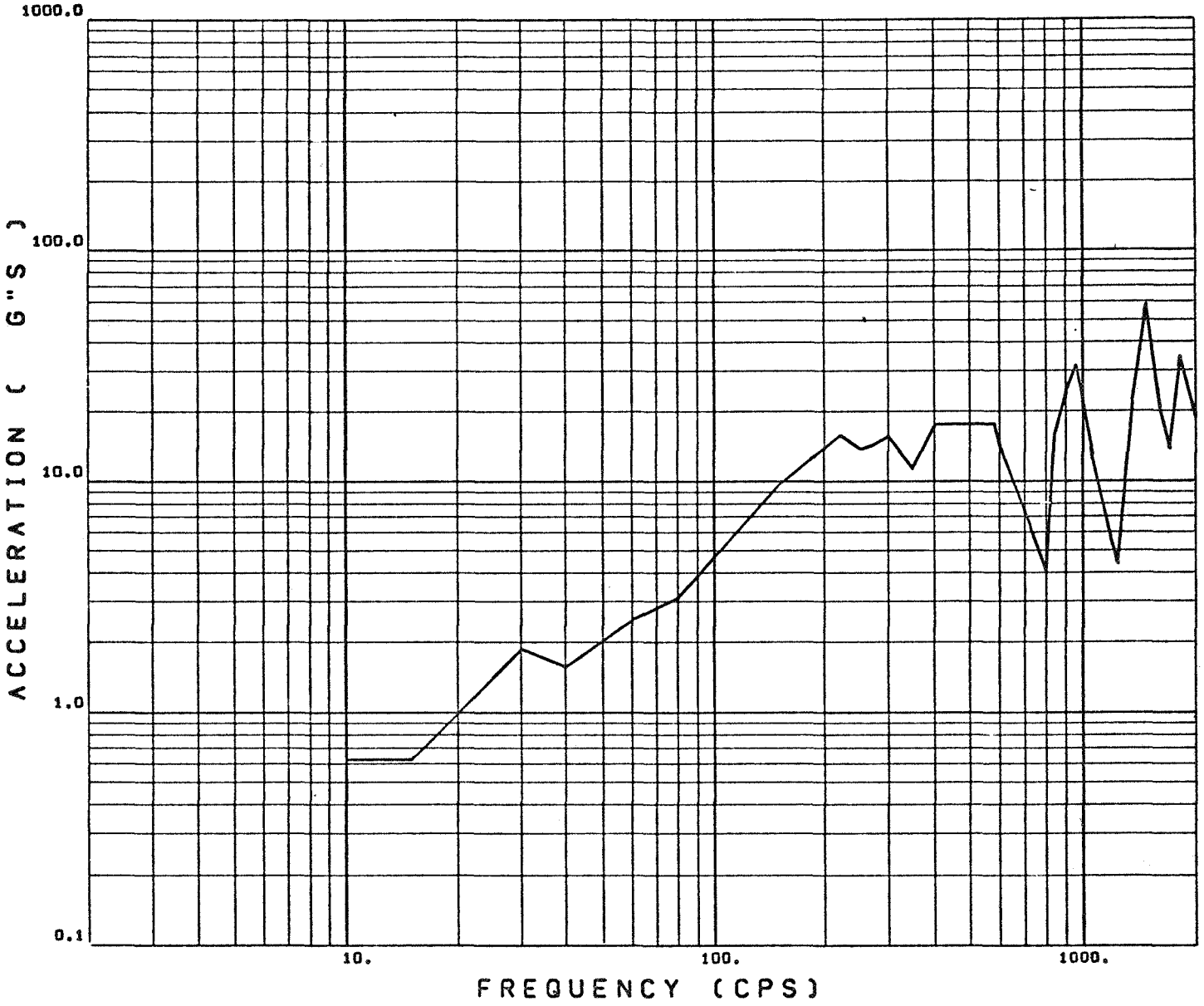
SINUSOIDAL FREQUENCY SWEEP

SIV-B CHILLDOWN SHUTOFF VALVE (FQ F-14A)

CONFIGURATION --- S/N 0201
NOTE... SEE PAGE _____
FOR PICK UP LOCATION

LEGEND...
UPSWEEP ———
DOWNSWEEP ------

TEST CONDITIONS....
TEST DATE..... 10/29/66
AXIS OF EXCITATION.... TANGENTIAL
PICK UP NUMBER (2)... 2 FILTERED
PICK UP RESPONSE..... TANGENTIAL
INPUT ACCEL.PER PAGE.. _____



DOUGLAS AIRCRAFT COMPANY , INC.

PAGE NO. _____
REPORT NO. _____

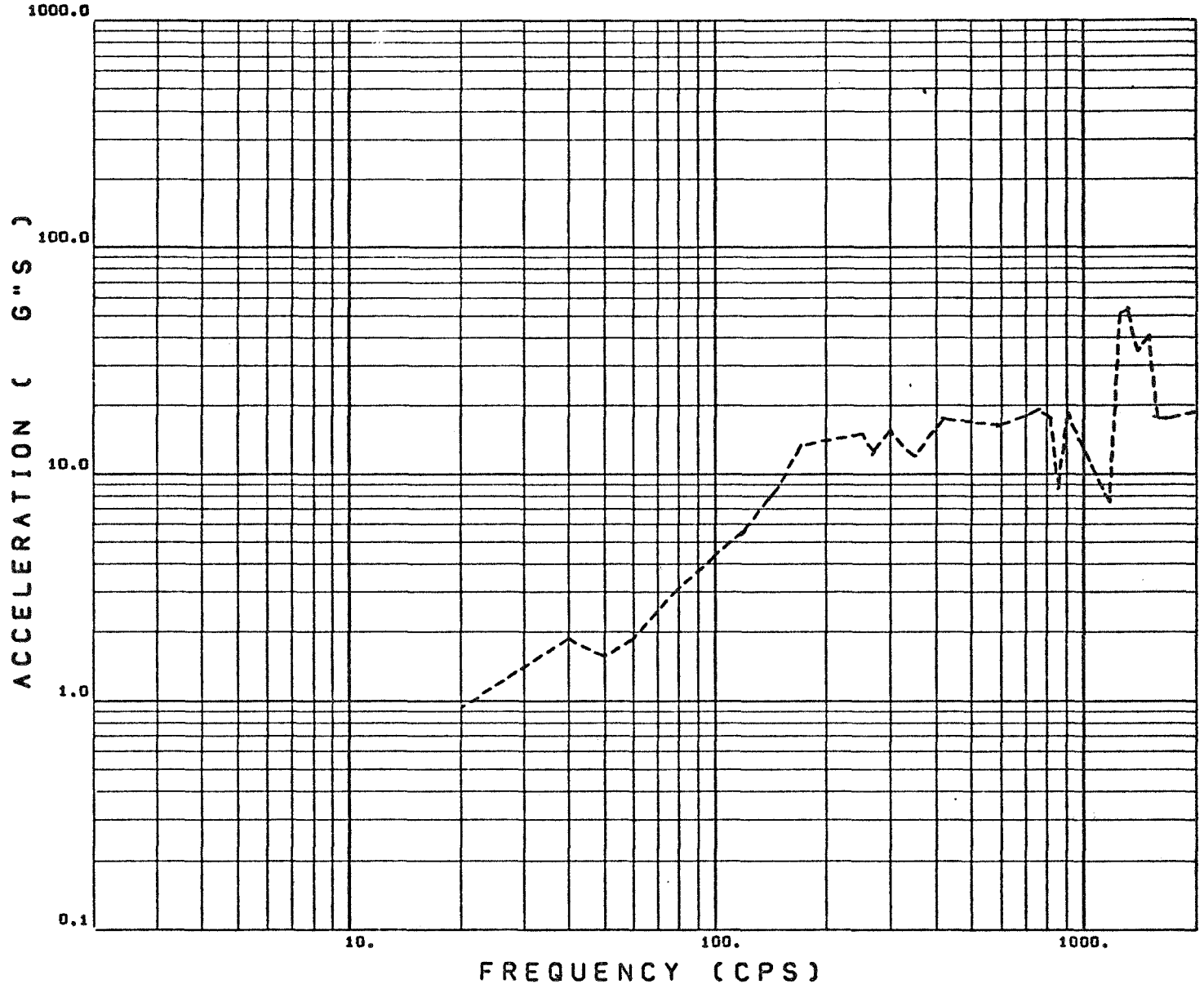
SINUSOIDAL FREQUENCY SWEEP

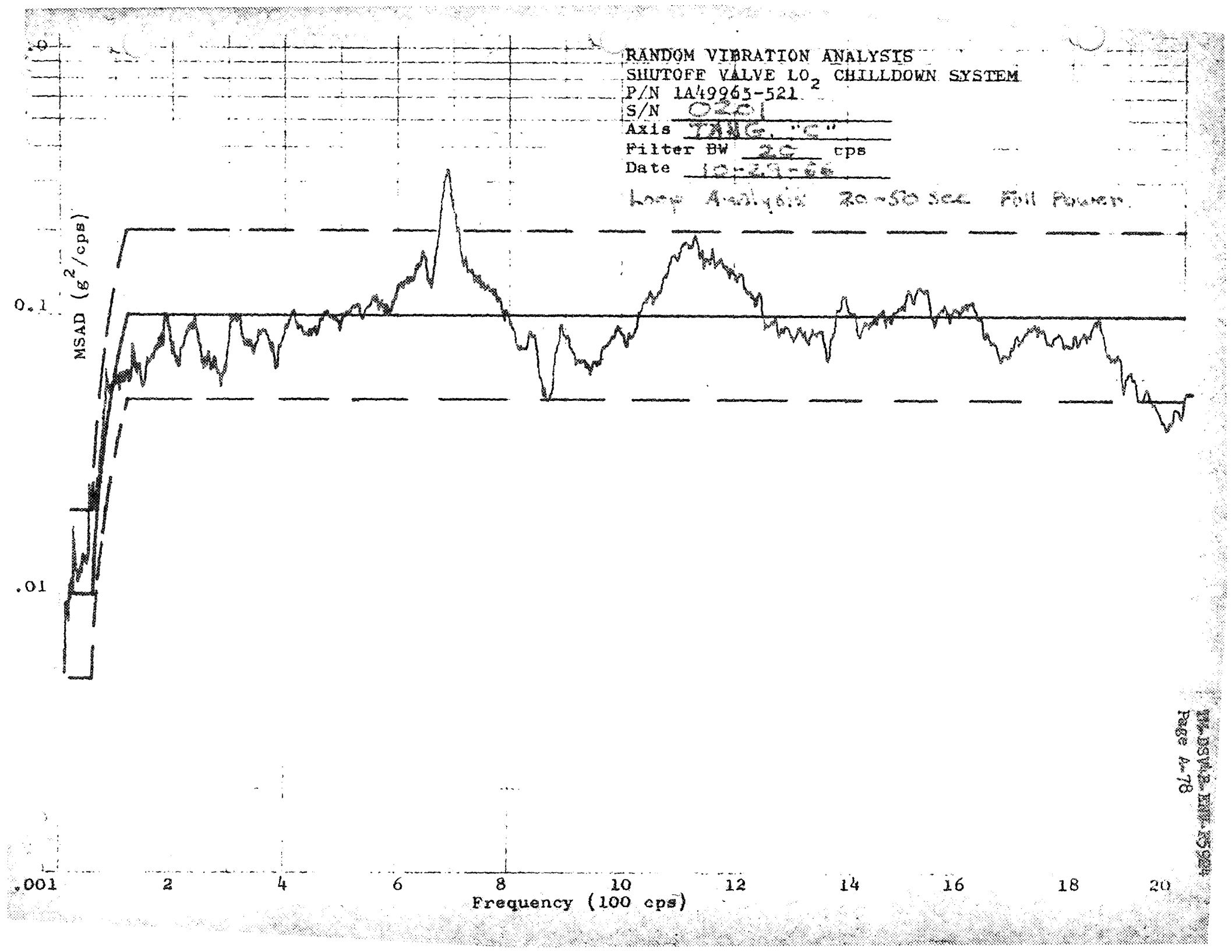
SIV-B CHILLDOWN SHUTOFF VALVE (FQ F-14A)

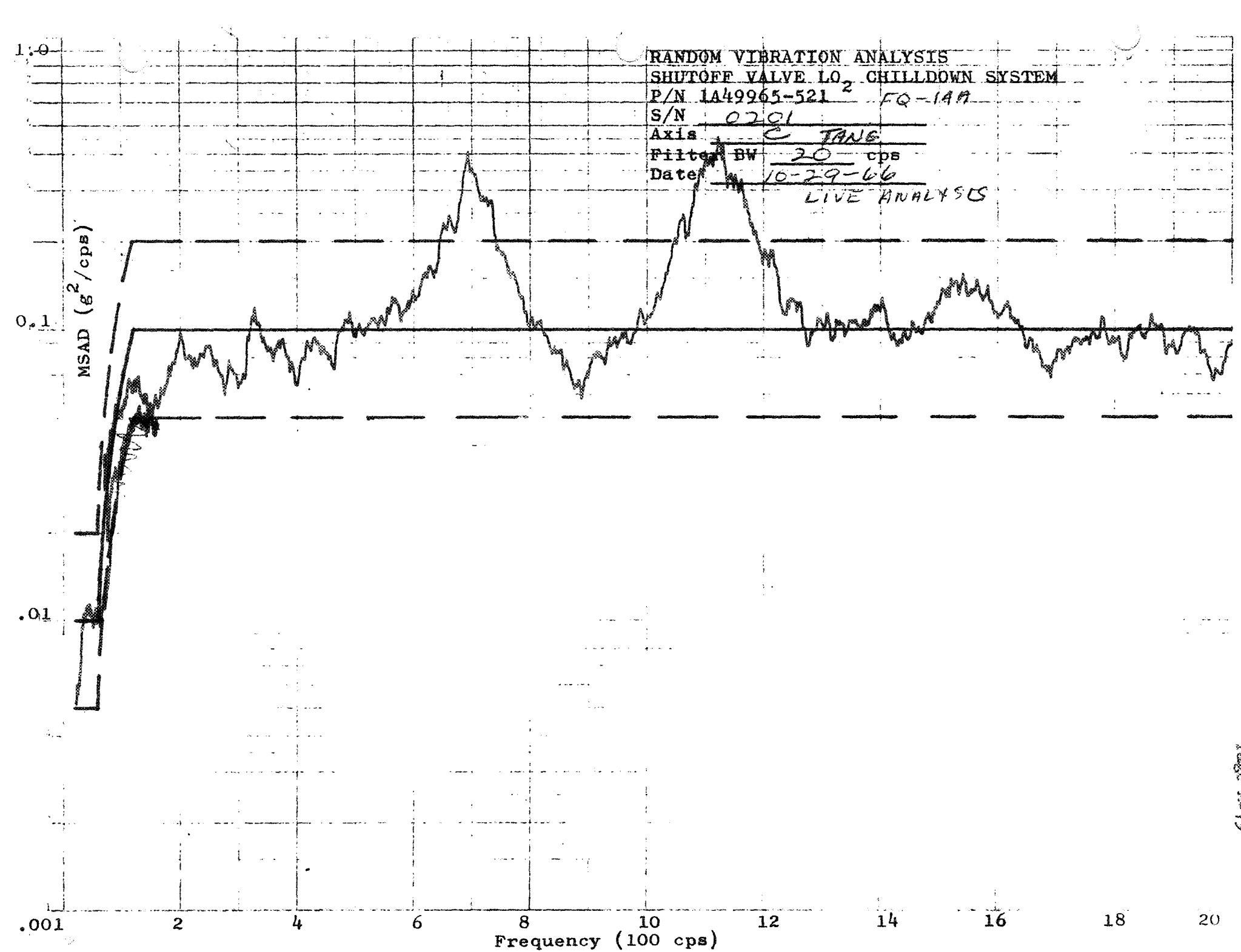
CONFIGURATION --- S/N 0201
NOTE... SEE PAGE _____
FOR PICK UP LOCATION

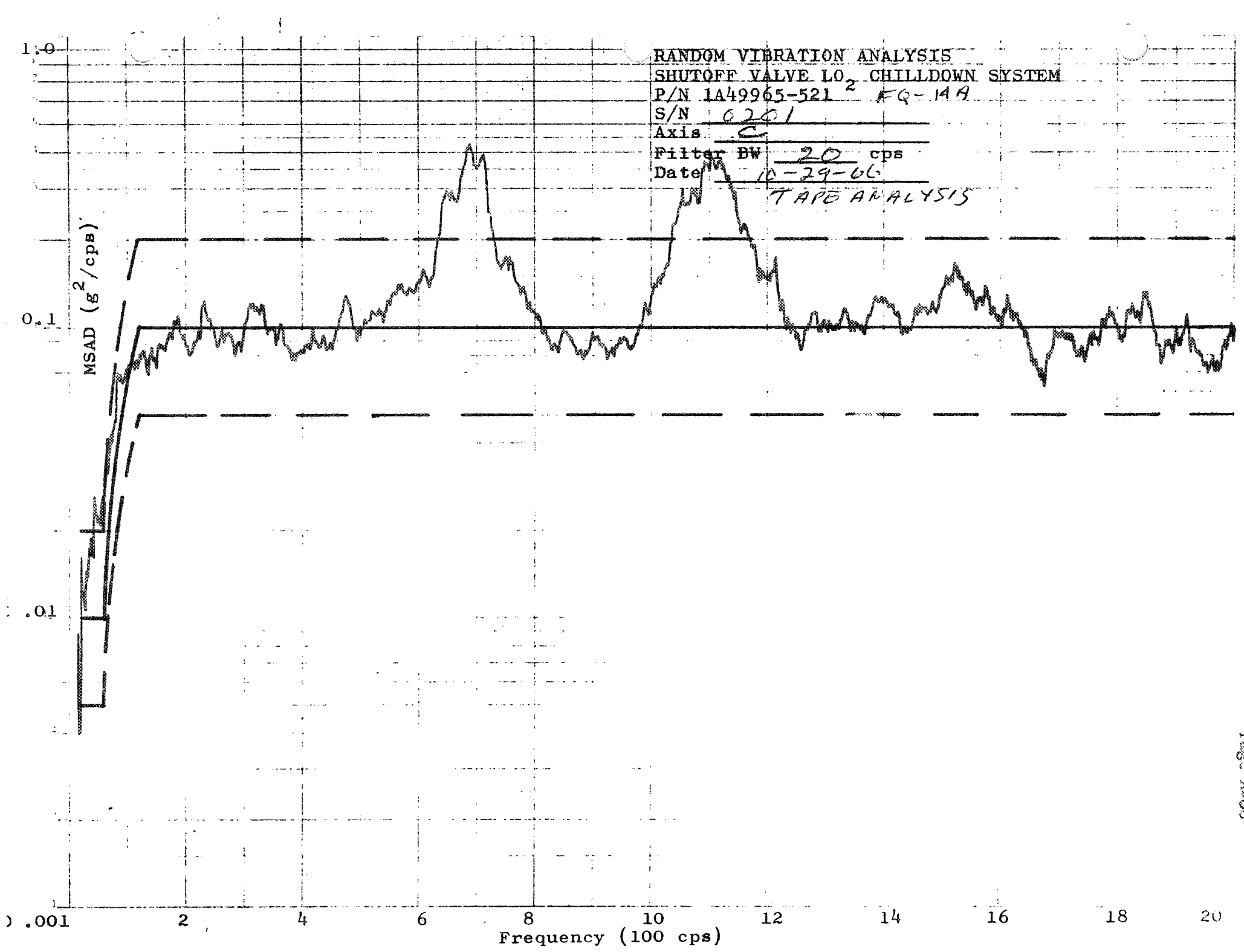
LEGEND...
UPSWEEP ——
DOWNSWEEP ------

TEST CONDITIONS....
TEST DATE..... 10/29/66
AXIS OF EXCITATION.... TANGENTIAL
PICK UP NUMBER (2)... 2 FILTERED
PICK UP RESPONSE..... TANGENTIAL
INPUT ACCEL.PER PAGE.. _____




RANDOM VIBRATION ANALYSIS
SHUTOFF VALVE LO2 CHILLDOWN SYSTEM
P/N 1A49965-521
S/N 0201
Axis TANG. "C"
Filter BW 20 cps
Date 10-23-66
Loop Analysis 20-50 Sec Full Power
MSAD (g²/cps)
.6
0.1
.01
.001
2
4
6
8
10
12
14
16
18
20
Frequency (100 cps)


RANDOM VIBRATION ANALYSIS
SHUTOFF VALVE LO2 CHILLDOWN SYSTEM
P/N 1A49965-521 FQ-149
S/N 0291
Axis C TAVE
Filter BW 20 cps
Date 10-29-66
LIVE ANALYSIS
1.0
0.1
.01
.001
MSAD (g²/cps)
2
4
6
8
10
12
14
16
18
20
Frequency (100 cps)


RANDOM VIBRATION ANALYSIS
SHUTOFF VALVE LO2 CHILLDOWN SYSTEM
P/N 1A49965-521 FQ-14A
S/N 0201
Axis C
Filter BW 20 cps
Date 10-29-66
TAPE ANALYSIS
MSAD (g²/cps)
1.0
0.1
.01
.001
2
4
6
8
10
12
14
16
18
20
Frequency (100 cps)

DSV-4B RANDOM VIBRATION TEST

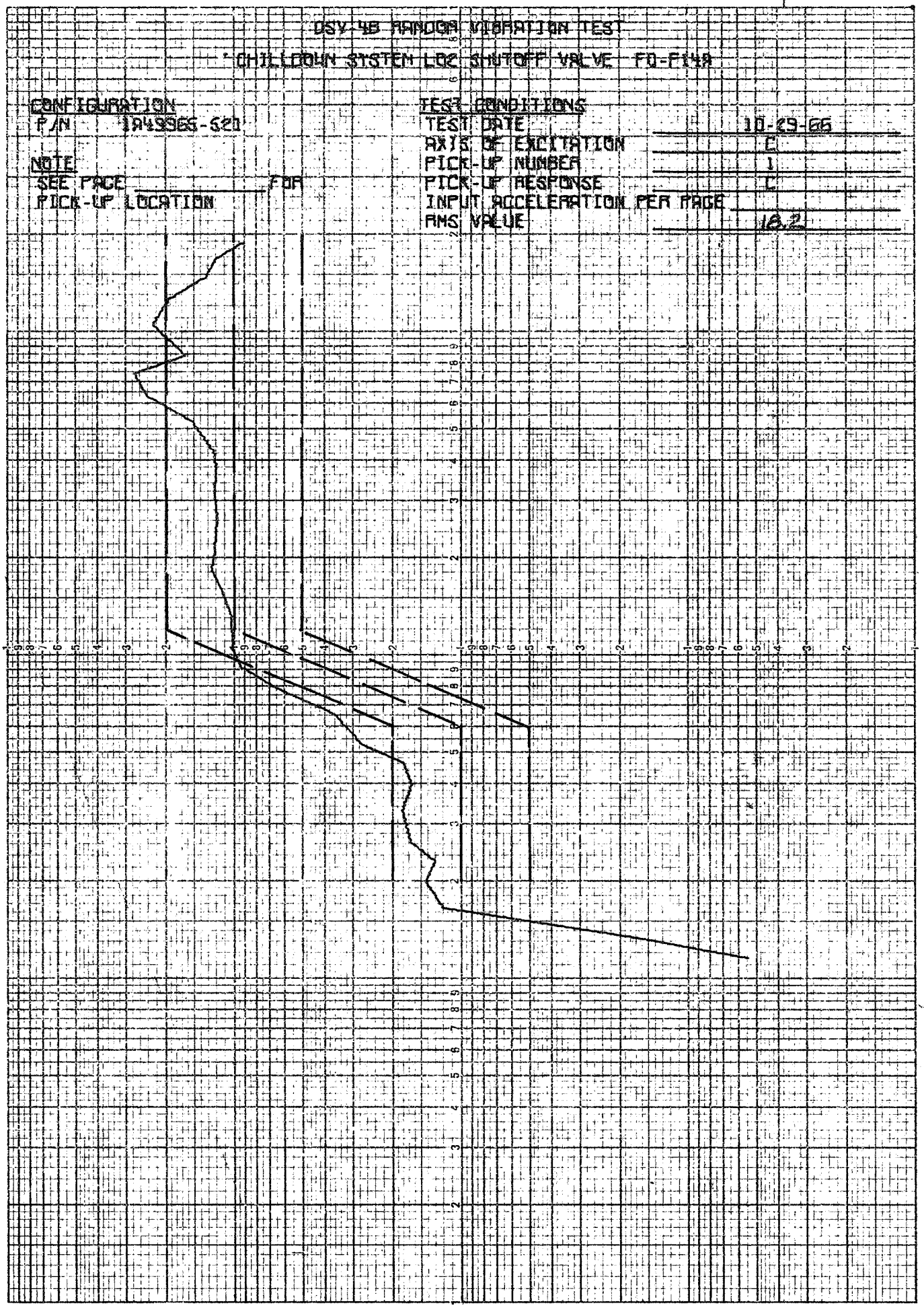
CHILLDOWN SYSTEM LOX SHUTOFF VALVE FO-F148

CONFIGURATION
P/N 1R43965-521

NOTE
SEE PAGE ____ FOR
PICK-UP LOCATION

TEST CONDITIONS

TEST DATE	10-29-66
AXIS OF EXCITATION	C
PICK-UP NUMBER	1
PICK-UP RESPONSE	C
INPUT ACCELERATION PER PAGE	
RMS VALUE	16.2



FORM 25-S-1
(REV. 8-53)

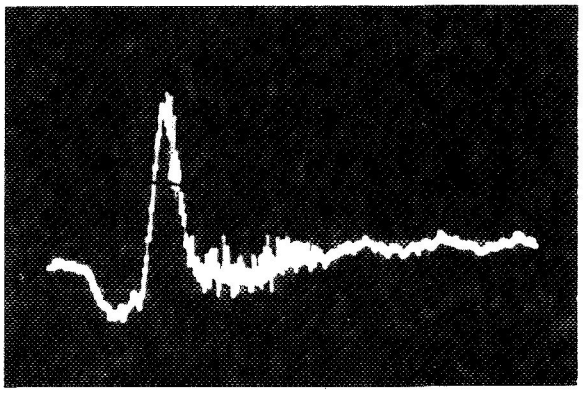
PREPARED BY: W. SLACK
CHECKED BY:
DATE: 10-29-66
TITLE: CHILLDOWN SHUTOFF VALVE TEST (F-14A)

DOUGLAS AIRCRAFT COMPANY, INC.
MISSILE & SPACE SYSTEMS DIVISION

PAGE:
MODEL: DSV-4B
REPORT NO.:

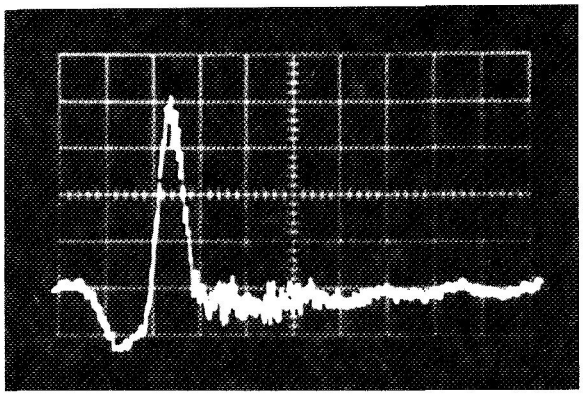
5769-6404
27903
1T07782

SHOCK PULSE
C AXIS



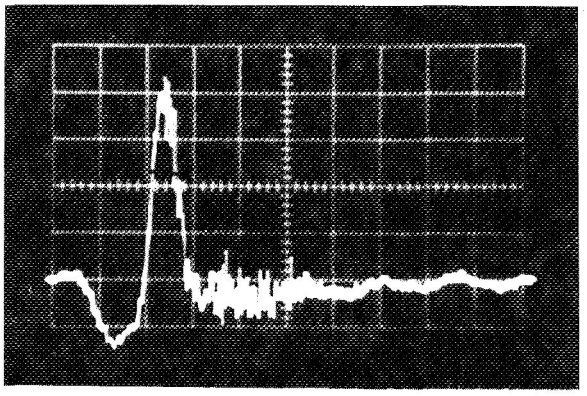
5 G's/DIVISION

10 MSEC/DIVISION



5 G's/DIVISION

10 MSEC/DIVISION



5 G's/DIVISION

10 MSEC/DIVISION

FORMAL QUALIFICATION TEST DATA SHEET

Item Name: LO_2 Chilldown System Shutoff Valve

Part Number: 1A49965-521

Test Procedure Drawing No.: 1T07783 Change Letter: C

Manufacturer's S/N: 0201 Test Plan Line Item: FQ-F-14A

Test Laboratory: Beech Aircraft Location: Boulder, Colorado

Douglas Test Representative: K. C. Tolides Date 10-29-66

Test Witness: _____ Douglas Q.C. _____ Customer Q.C.

Vibration Test Per Paragraph: 5.15

Test Specimen No.: 1

	Sine	Random
Test Start (Date, Time):	10-29-66, @ 2230	, @ N/A
Test Completed (Date, Time):	10-29-66, @ 2300	, @ N/A

Ambient Room Conditions:	Temperature °F	RH %	Atm. Press. In Hg Abs.
	66	36	627 mm

RE-RUN OF 5 TO 18 CPS PORTION ONLY.

Sinusoidal Sweep Test Axis Orientation: THRUST "A"

	Sweep Rate Octave/Minute	Frequency cps	Amplitude
Required	1.0	5 to ~~24~~ 18	0.032 In. D.A.
Actual	NOTE: Sweep Rates Approx. 1.0 Oct/Min.	5 TO 18	0.032 IN. D.A.
Required		24 to 47	1.0 G Peak
Actual		N/A	N/A
Required		47 to 200	0.0088 In. D.A.
Actual		N/A	N/A
Required	Total Run Time	200 to 2000	17.5 G Peak
Actual	1 Min. 50 Sec.	N/A	N/A

FORMAL QUALIFICATION TEST DATA SHEET

Item Name: LO_2 Chilldown System Shutoff Valve

Part Number: 1A49965-521

Test Procedure Drawing No: 1T07783 Change Letter: C

Manufacturer's S/N: 0201 Test Plan Line Item: FQ-F-14A

Test Laboratory: Beech Aircraft Location: Boulder, Colorado

Douglas Test Representative: K. C. Tolides Date: 10-30-66

Test Witness: [signature] [signature]
Douglas Q.C. Customer Q.C.

Proof Pressure Test Per Paragraph: 5.9 Post Vibration and Shock

Test Specimen No: 1

Test Start (Date, Time): 10-30-66, 1700

Test Completed (Date, Time): 10-30-66, 1905

Ambient Room Conditions:

Temperature °F	RH %	Atm. Press. In. Hg abs.
65	25	623 mm

Valve Body

Test Parameter	Units	Required	Actual
Temperature	°F	-300 (±20)	-300
Pressure	psig	190	190
Time	minutes	5	5

Actuator

Test Parameter	Units	Required	Actual
Temperature	°F	Ambient	65
Pressure	psig	750	750
Time	minutes	5	5

Accept: X Reject:

Comments:

FORMAL QUALIFICATION TEST DATA SHEET

Item Name: LO_2 Chilldown System Shutoff Valve

Part Number: 1A49965-521

Test Procedure Drawing No: 1T07783 Change Letter:

Manufacturer's S/N: 0201 Test Plan Line Item: FQ-F-14A

Test Laboratory: BEECH AIRCRAFT Location: BOULDER, COLORADO

Douglas Test Representative: K. C. TOLIDES Date: 10-30-66

Test Witness: [signature] 1220 [signature]
Douglas Q. C. Customer Q. C

External Leakage Test Per Paragraph: 5.10.1 POST VIBRATION AND SHOCK

Test Specimen No: 1

Test Start (Date, Time): 10-30-66, 1710

Test Completed (Date, Time): 10-30-66, 1715

Ambient Room Conditions:

Temperature °F	RH %	Atm. Press. In. Hg abs.
64	25	623 mm

External Leakage

Test Parameter	Units	Required	Actual
Specimen Temperature	°F	Stabilized	64
Leakage Rate	scch	1.0	1.6×10^{-4}
Inlet Pressure	psig	125 Maximum	125
Time Maintained	Minutes	5	5

Accept: X Reject:

Comment:

FORMAL QUALIFICATION TEST DATA SHEET

Item Name: LO_2 Chilldown System Shutoff Valve

Part Number: 1A49965-521

Test Procedure Drawing No: 1T07783 Change Letter: C

Manufacturer's S/N: 0201 Test Plan Line Item: FQ-F-14A

Test Laboratory: BEECH AIRCRAFT Location: BOULDER, COLORADO

Douglas Test Representative: K.C. TOLIDES Date: 10-30-66

Test Witness: H. H Pratt 1120 (Douglas Q. C.) (Customer Q. C.)

Internal Leakage Test Per Paragraph: 5.10.2.2 POST VIBRATION AND SHOCK

Test Specimen No: 1

Test Start (Date, Time): 10-30-66, 1940

Test Completed (Date, Time): 10-30-66, 2000

Ambient Room Conditions:

Temperature °F	RH %	Atm. Press. In. Hg abs.
60	25	623 mm

Gate Seal

Test Parameter	Units	Required	Actual
Specimen Temperature	°F	Stabilized	N/A
Inlet Pressure	psig	80 Maximum	N/A
Actuator Port Pressure	psig	475	N/A
Leakage Rate	scim	30	N/A
Time Maintained	minutes	5	N/A

Actuator

Test Parameter	Units	Required	Actual
Actuator Port Pressure	psig	475	475
Specimen Temperature	°F	Ambient	60
Leakage Rate	scch	1.0	> 1.0 *
Maintained	minutes	5	5

* MASS SPECTROMETER PEGGED RAPIDLY.

FORMAL QUALIFICATION TEST DATA SHEET

Item Name: LO_2 Chilldown System Shutoff Valve

Part Number: 1A49965-521

Test Procedure Drawing No: 1T07783 Change Letter: C

Manufacturer's S/N: 0201 Test Plan Line Item: FQ-F-14A

Test Laboratory: BEECH AIRCRAFT Location: BOULDER, COLORADO

Douglas Test Representative: K. C. TOLIDES Date: 10-31-66

Test Witness: R. H. Pratt ITEO / [illegible]
Douglas Q. C. Customer Q. C.

Internal Leakage Test Per Paragraph: 5.10.2.2

Test Specimen No: 1

Test Start (Date, Time): 10-31-66, 1030

Test Completed (Date, Time): 10-31-66, 1145

Ambient Room Conditions:

Temperature °F	RH %	Atm. Press. In. Hg abs.
62	40	623 mm

Gate Seal

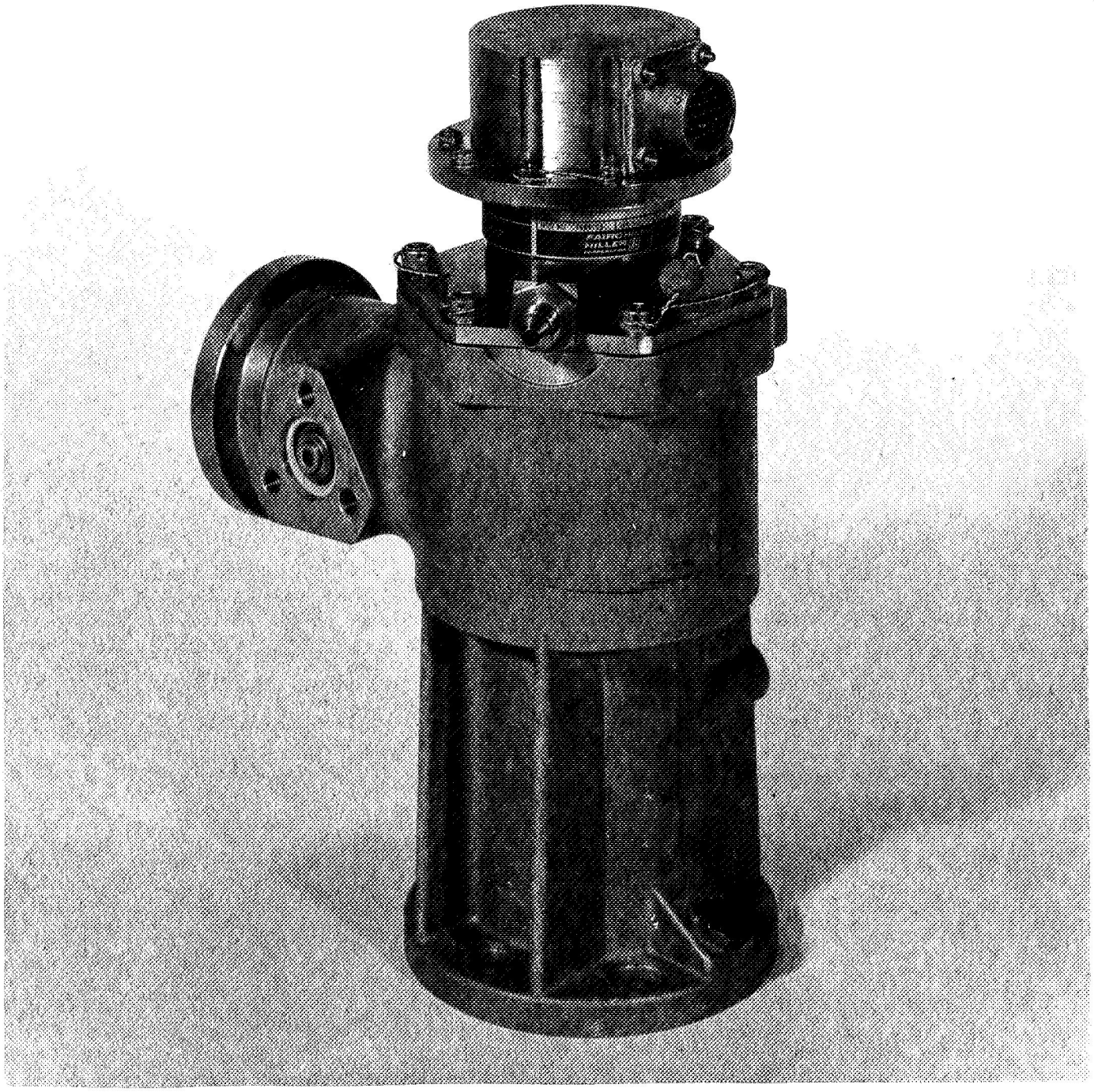
Test Parameter	Units	Required	Actual
Specimen Temperature	°F	Stabilized	N/A
Inlet Pressure	psig	80 Maximum	N/A
Actuator Port Pressure	psig	475	N/A
Leakage Rate	scim	30	N/A
Time Maintained	minutes	5	N/A

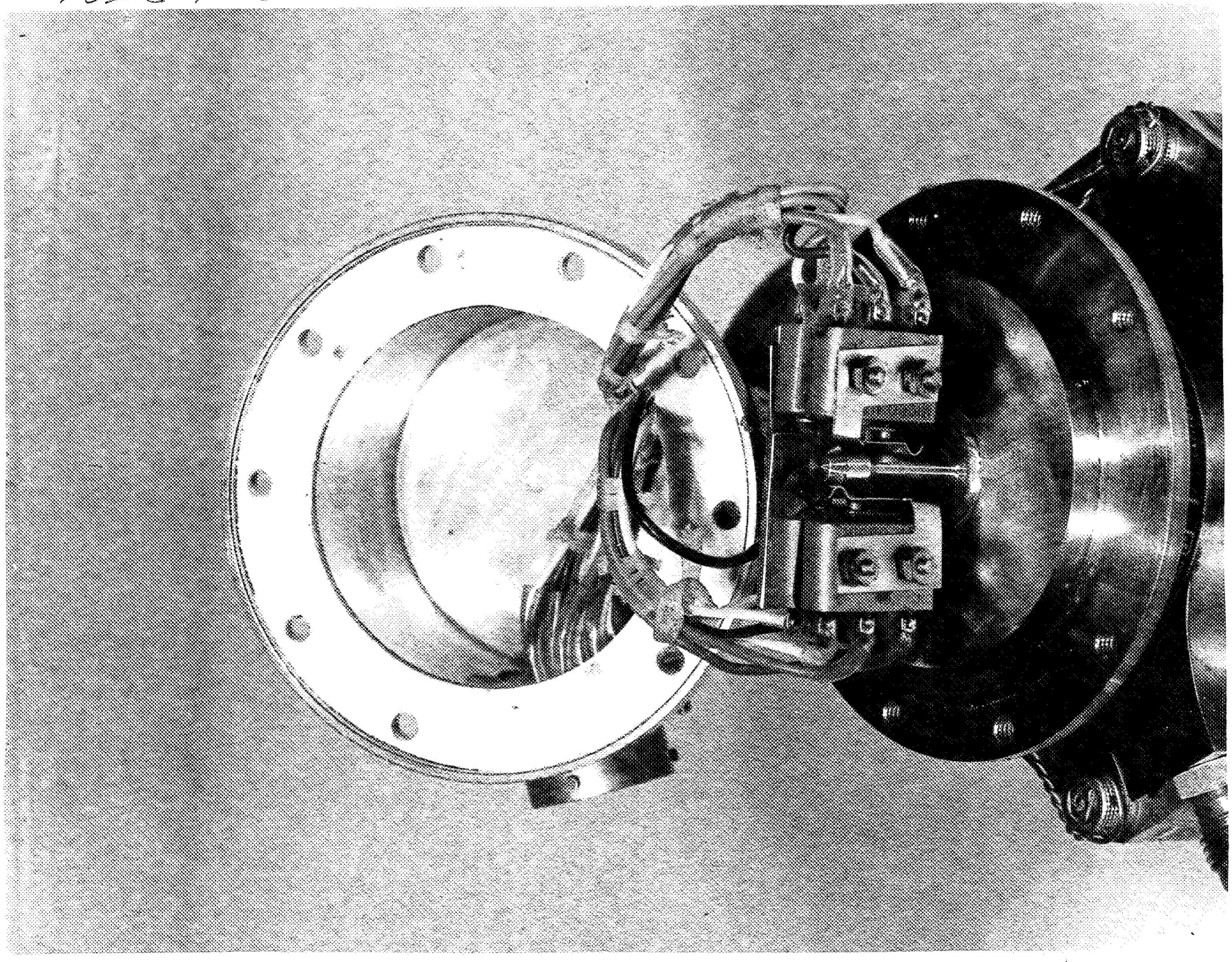
Actuator

Test Parameter	Units	Required	Actual
Actuator Port Pressure	psig	475	475
Specimen Temperature	°F	Ambient	62
Leakage Rate	scch	1.0	32,570 *
Maintained	minutes	5	5

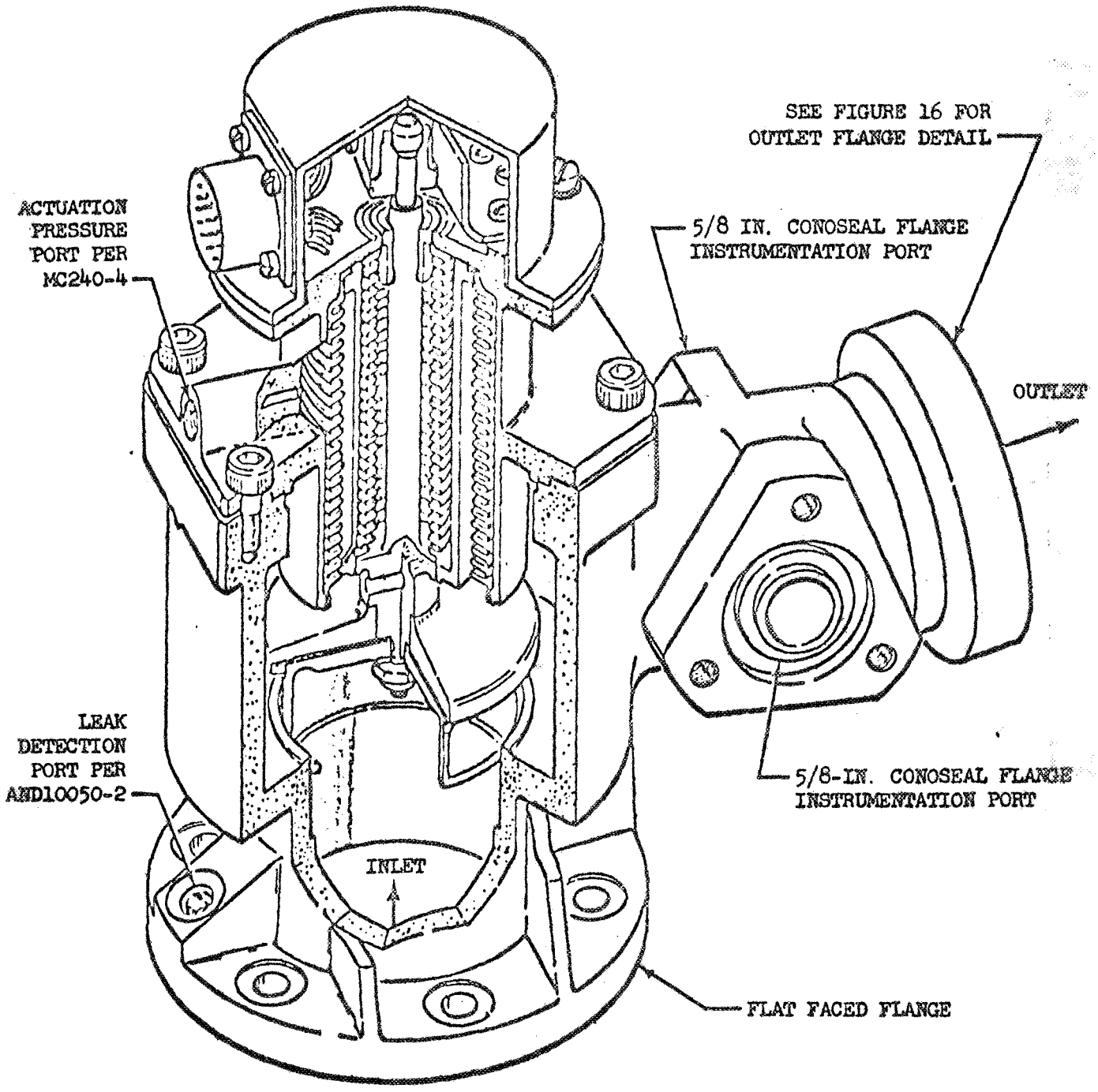
* FAILURE - RETURNED TO VENDOR

ADDENDUM B
PHOTOGRAPHS

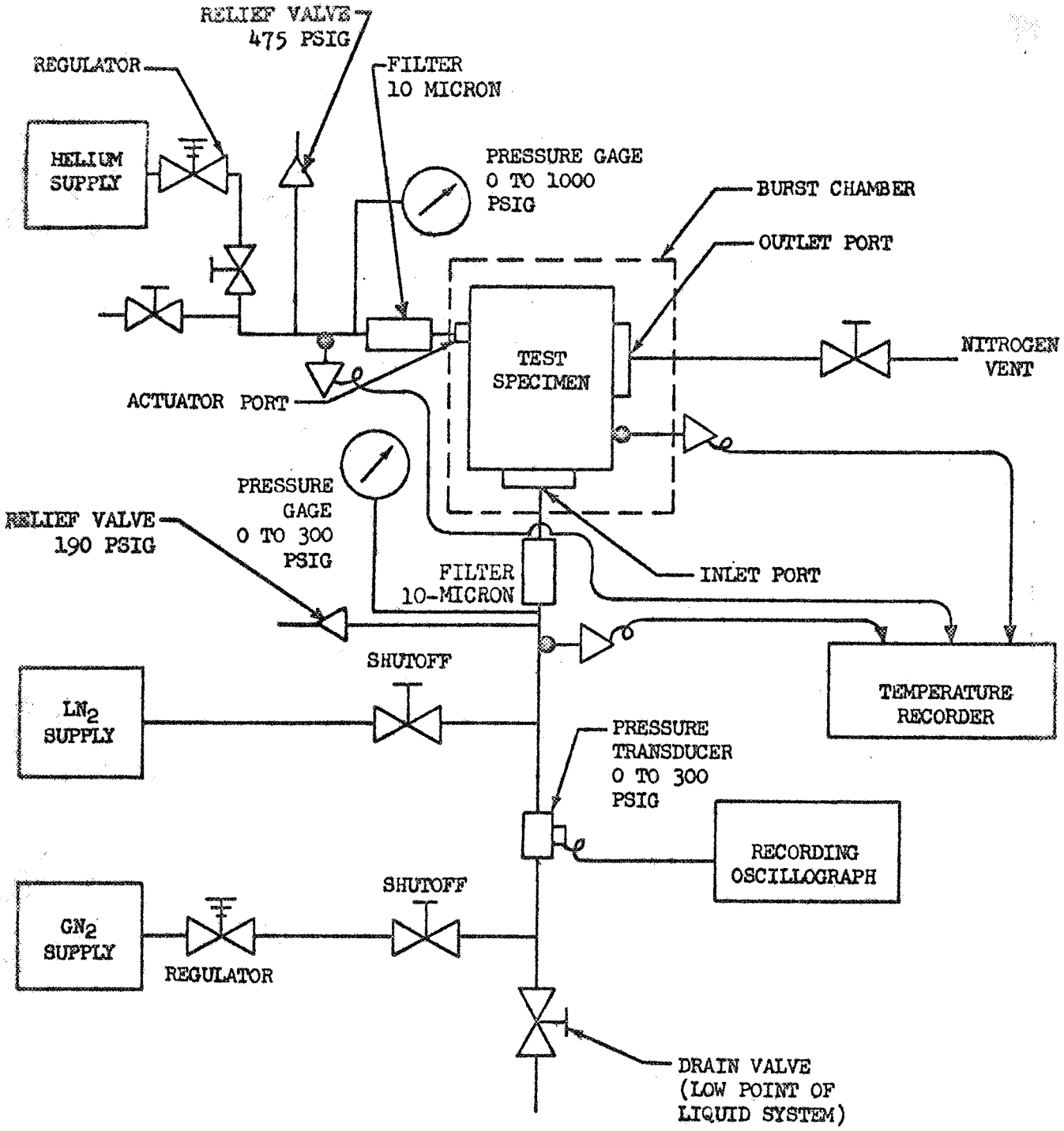




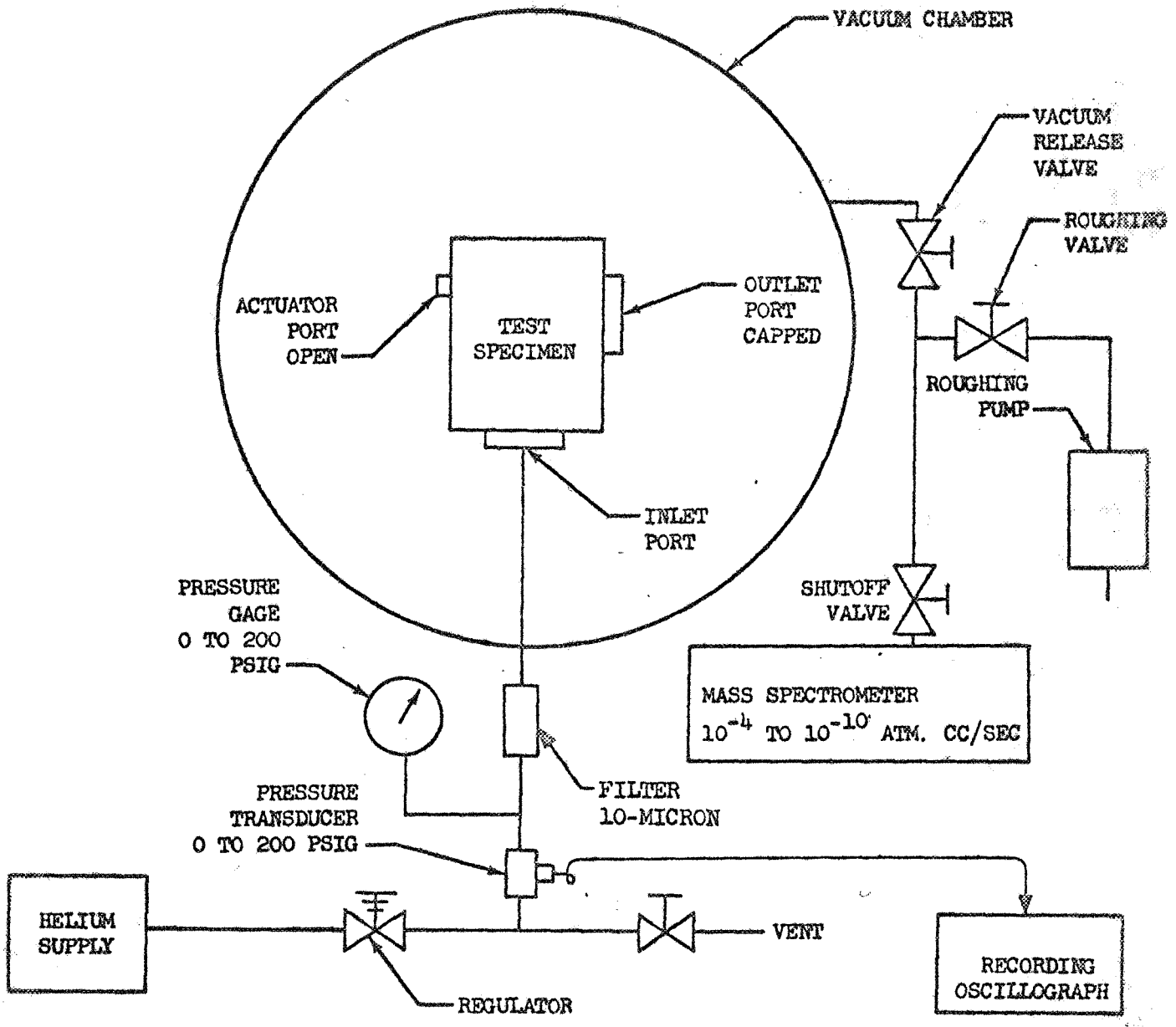
ADDENDUM C
SCHEMATICS



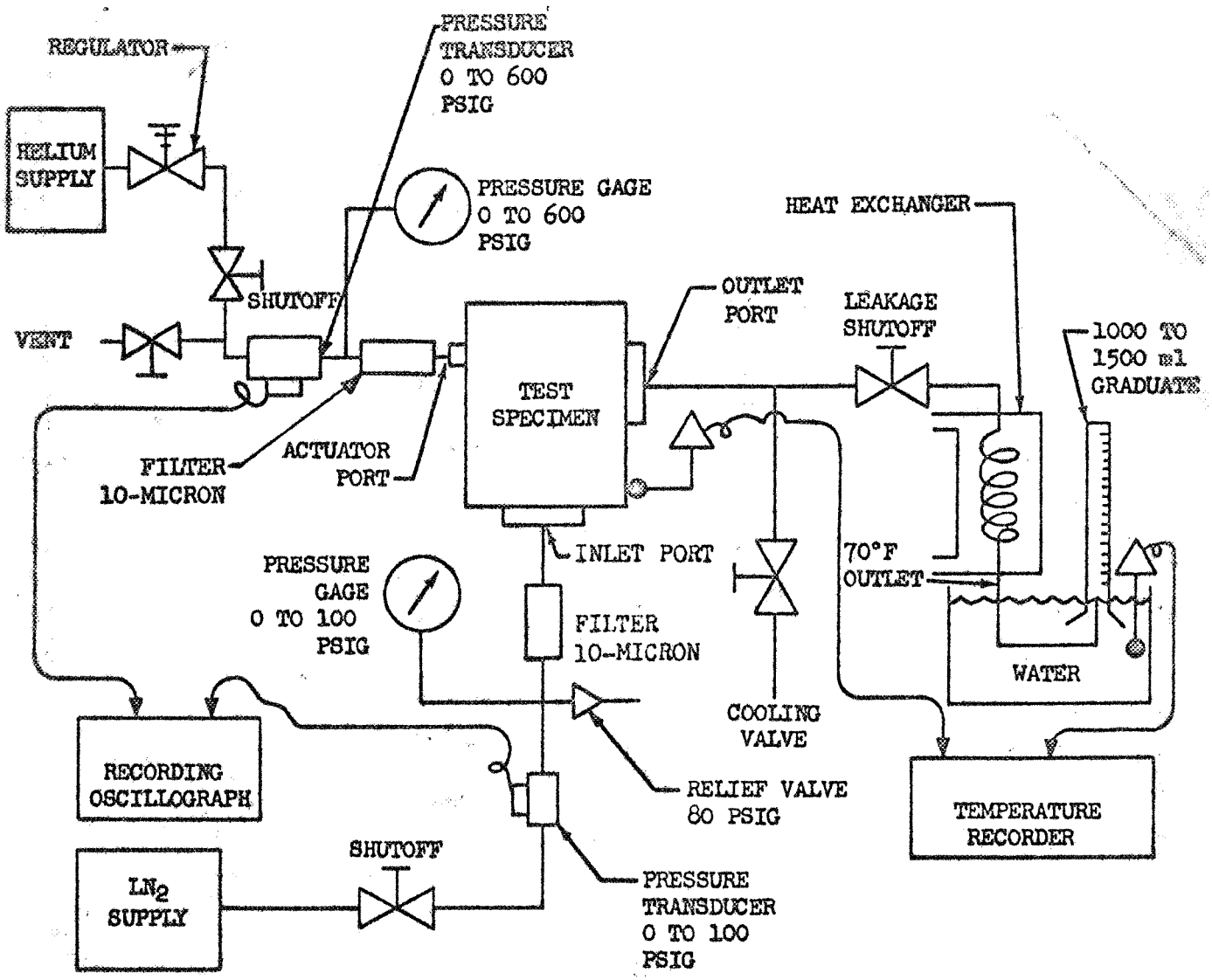
LO_2 Chilldown System Shutoff Valve, P/N 1A49965-521.



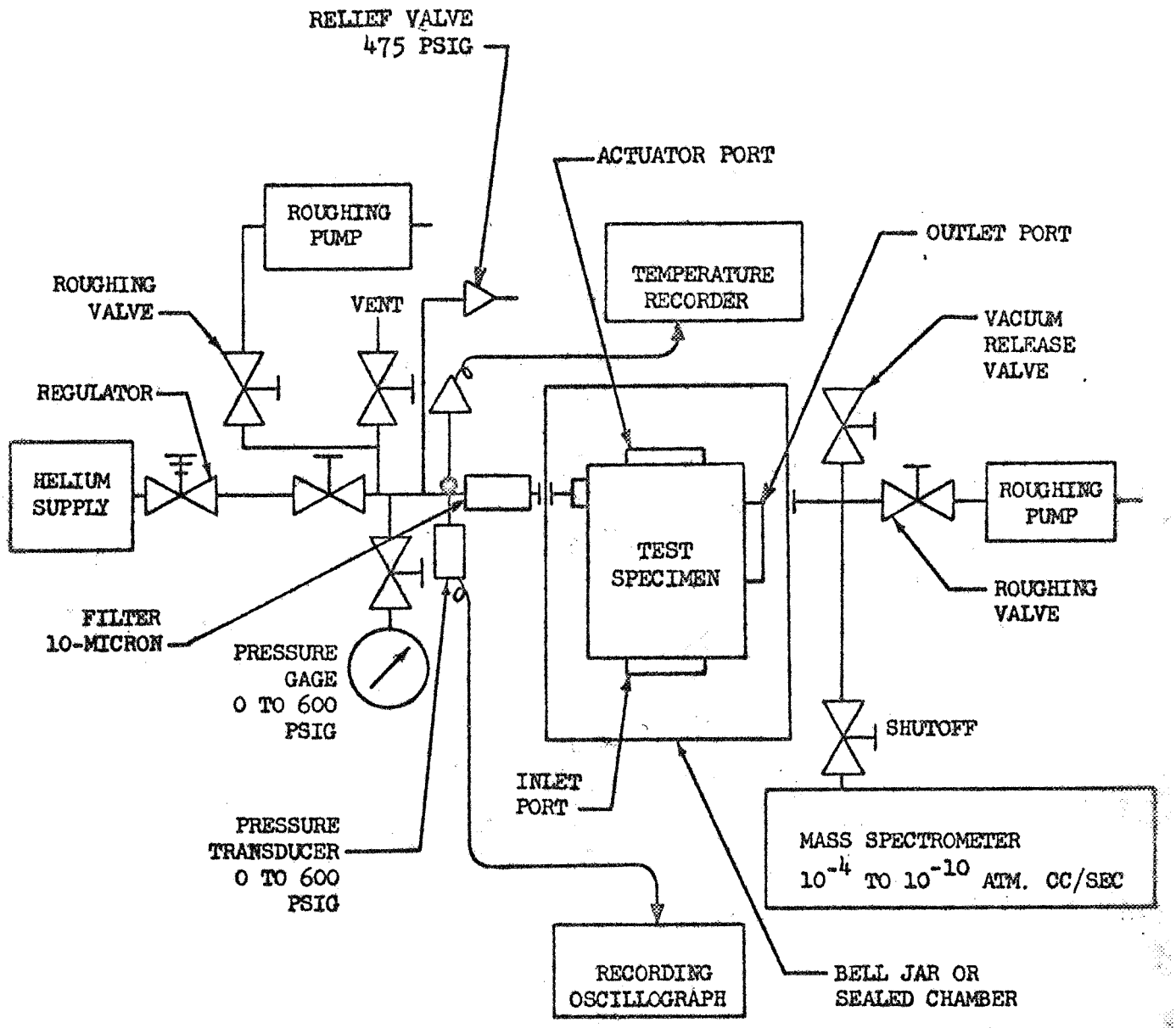
Proof Pressure Test, Schematic Diagram



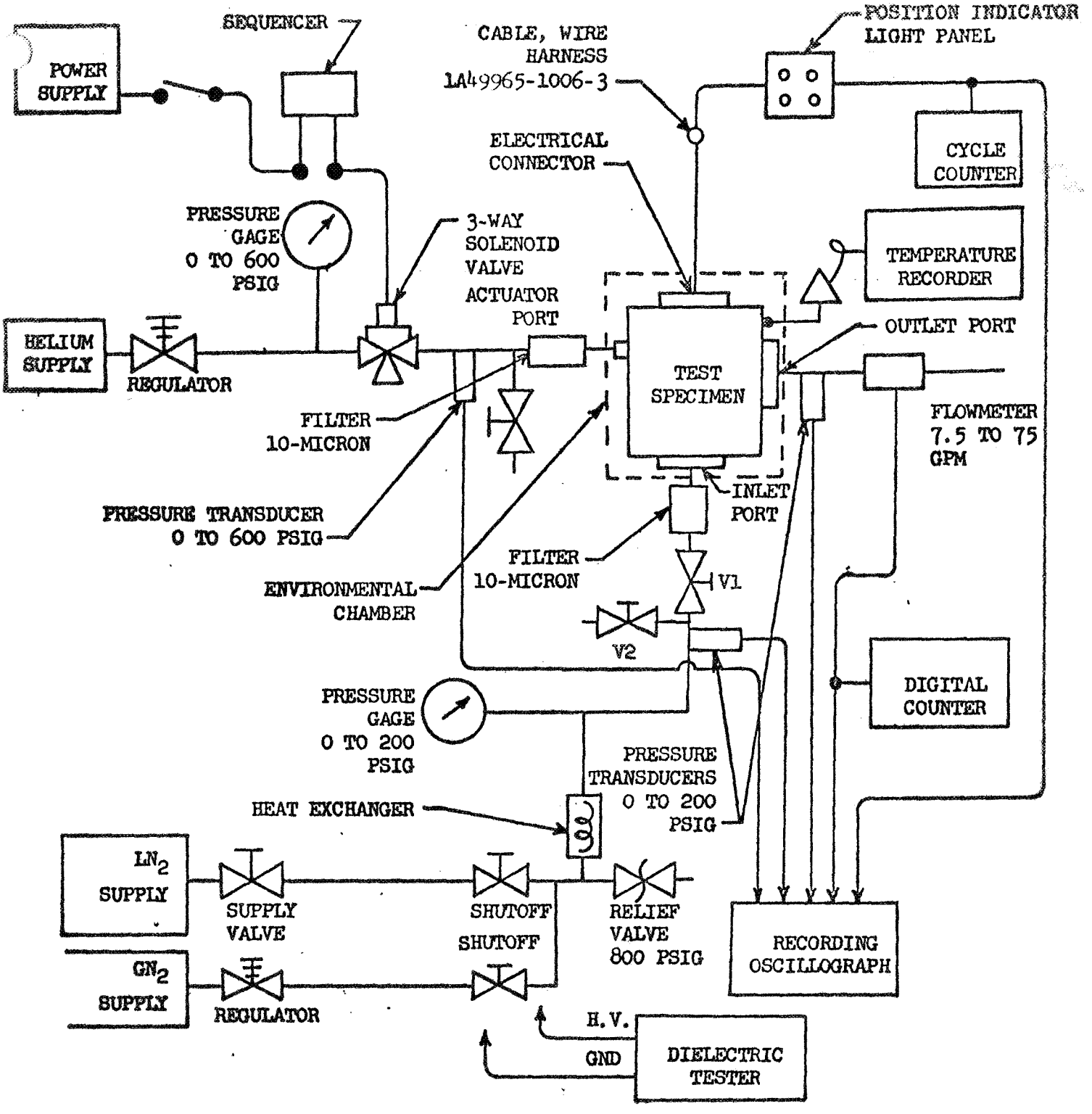
External Leakage Test, Schematic Diagram



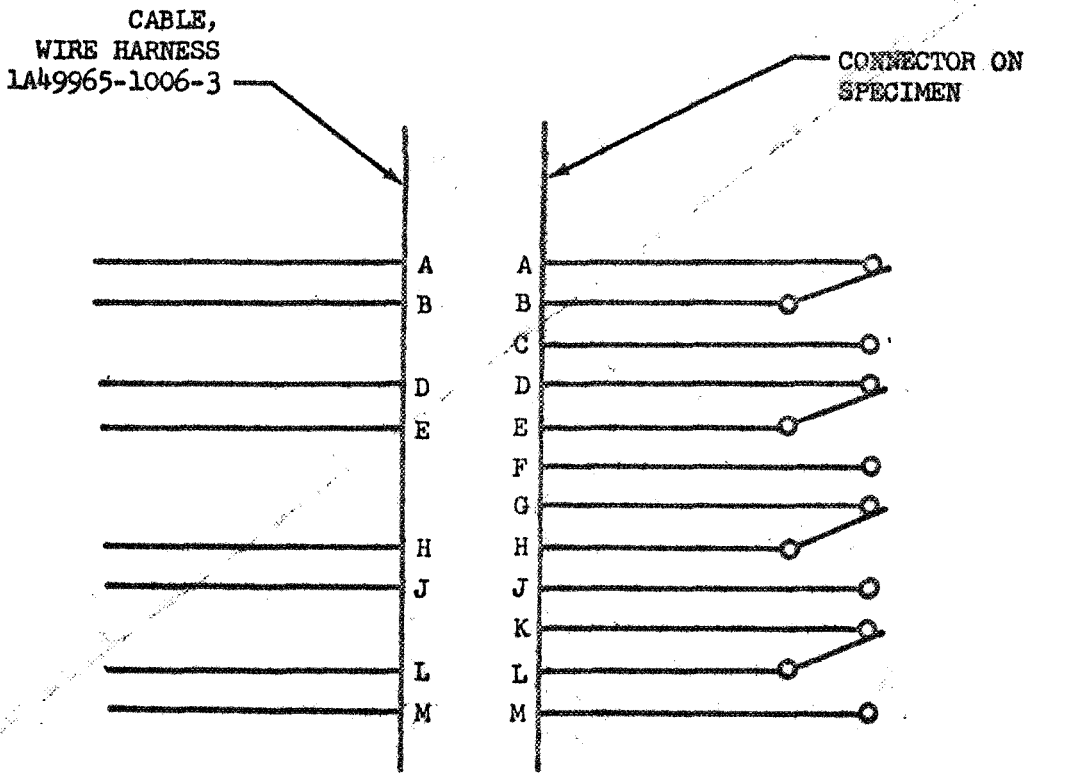
Gate Seal Internal Leakage Test, Schematic Diagram



Actuator Internal Leakage Test, Schematic Diagram

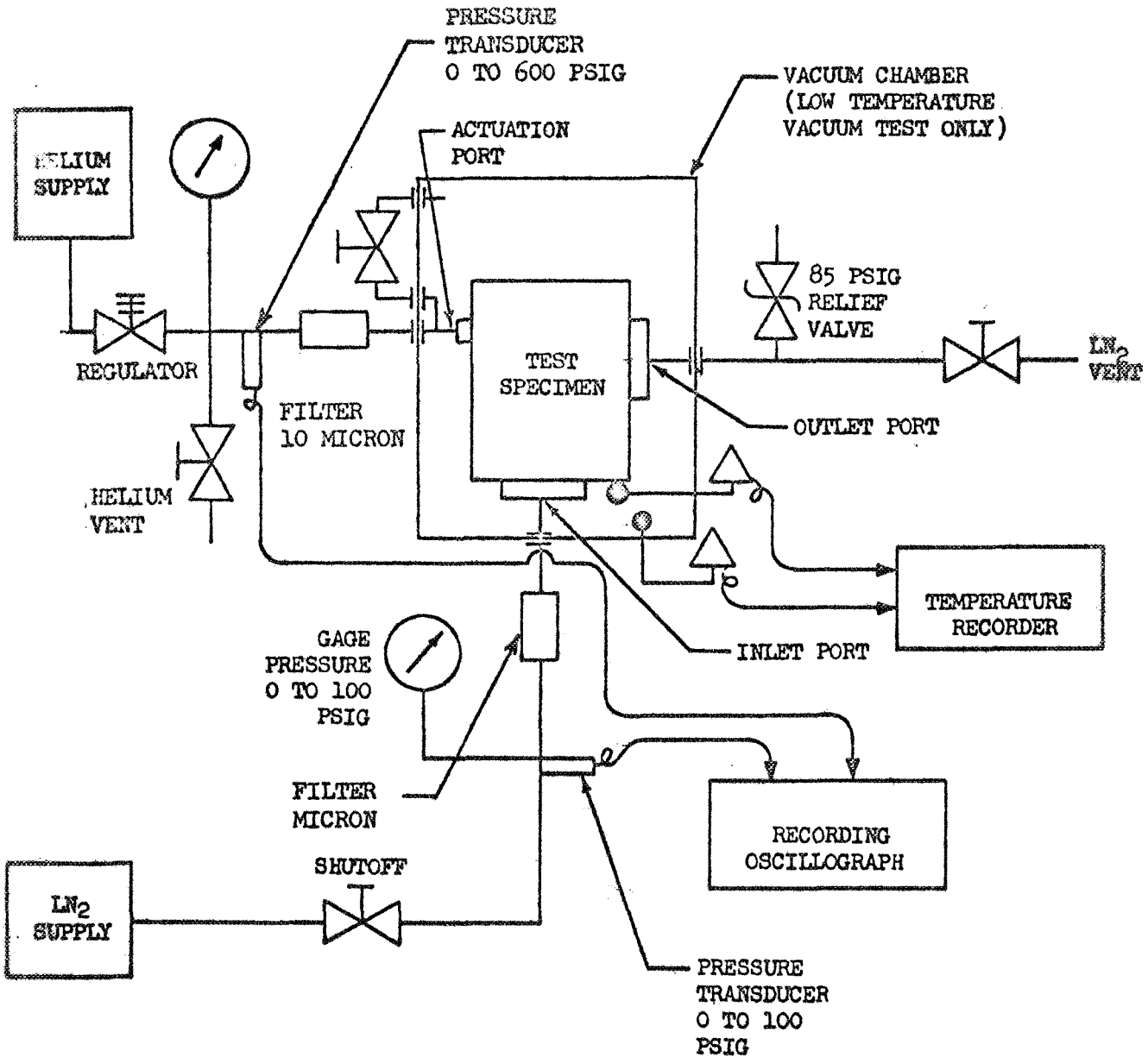


Functional Test and Repeat Cycle Tests, Schematic Diagram

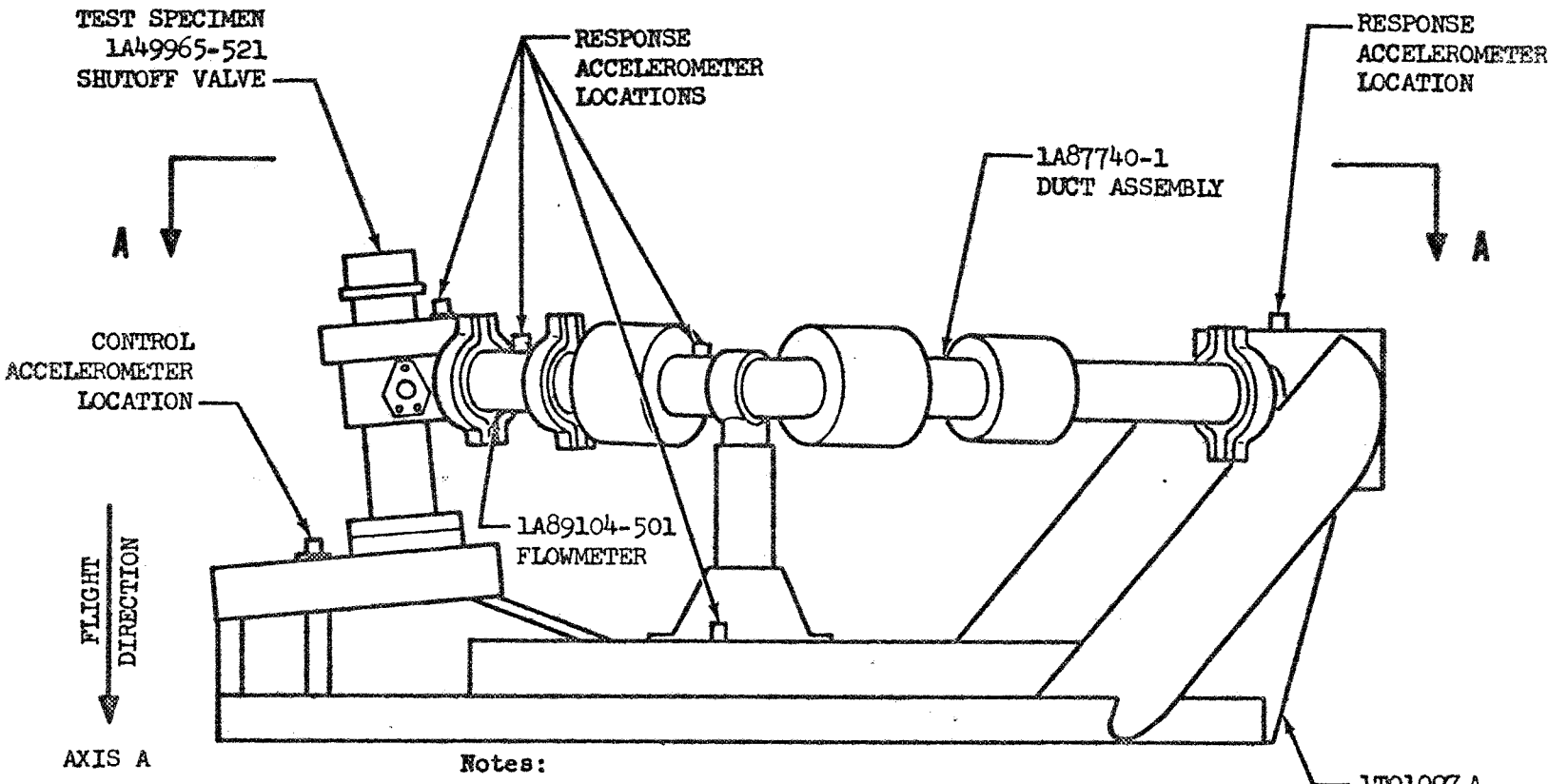


NOTE: SWITCHES ARE SHOWN FOR THE
VALVE IN THE FULL OPEN POSITION

Electrical Connector Pin Assignment



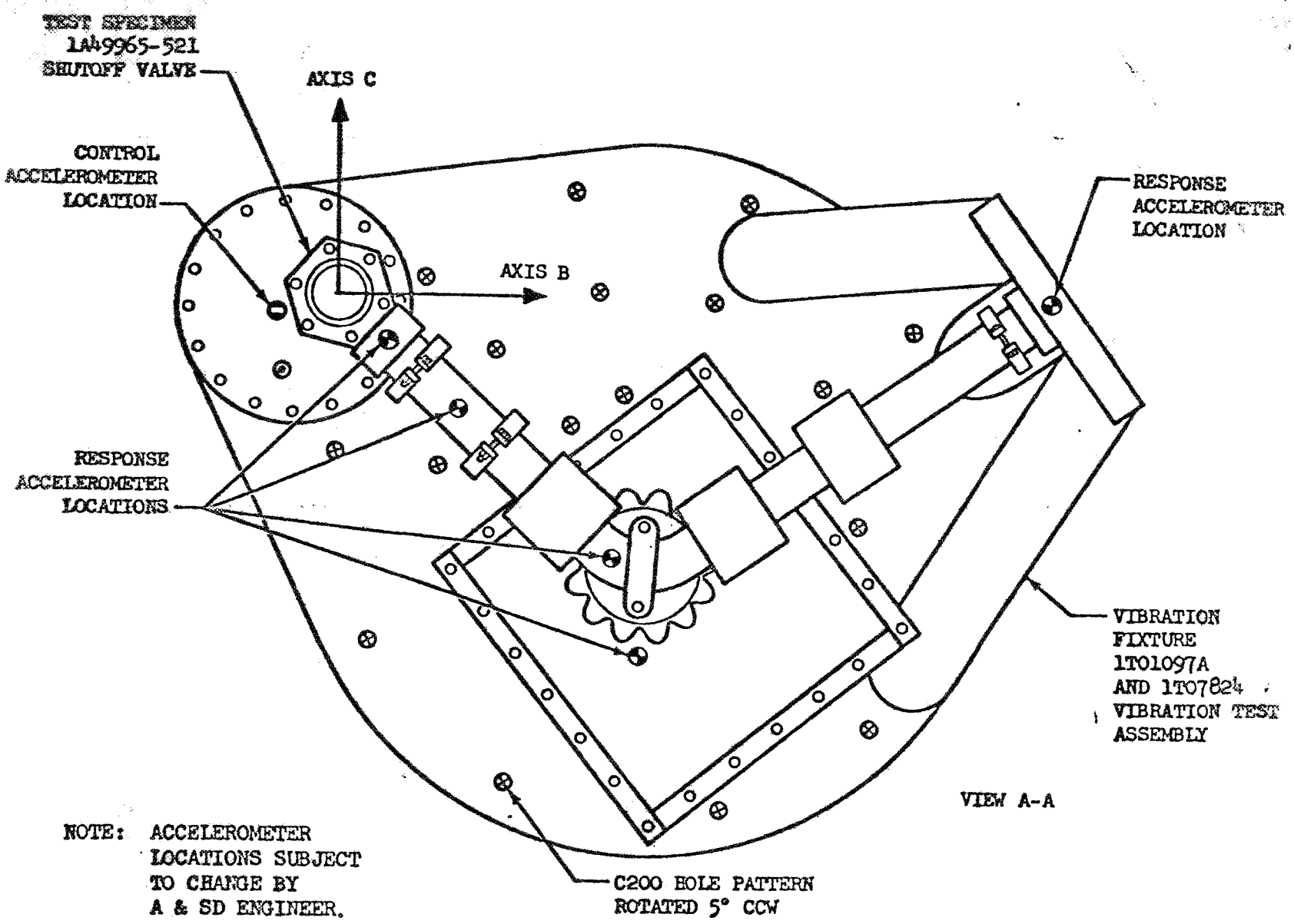
Low Temperature Vacuum and Vibration Test, Schematic Diagram



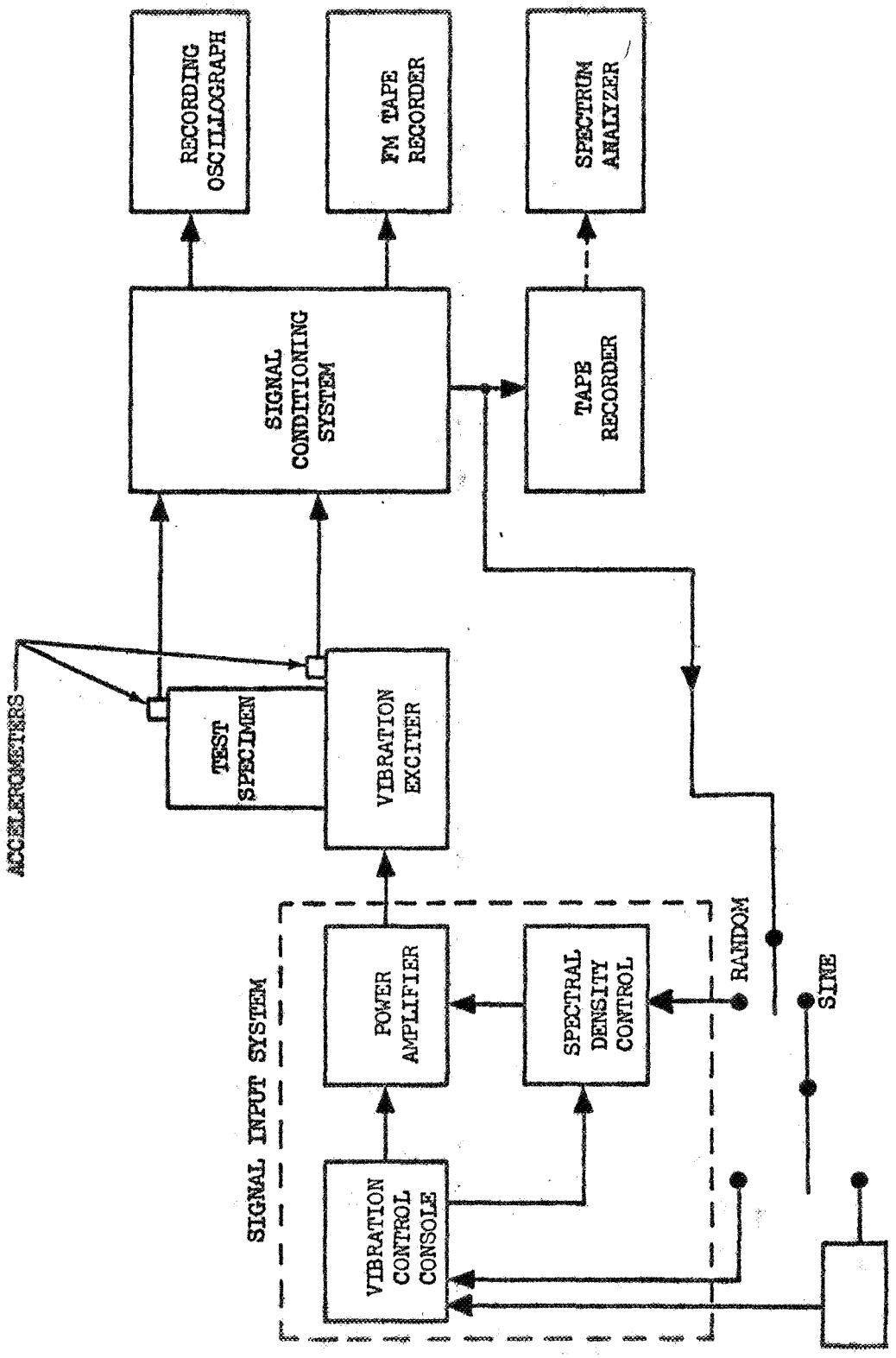
Notes:

1. Accelerometer locations are the same for all axes.
2. Response accelerometers are oriented in the direction of vibration or shock.
3. View A-A is shown on page C-10

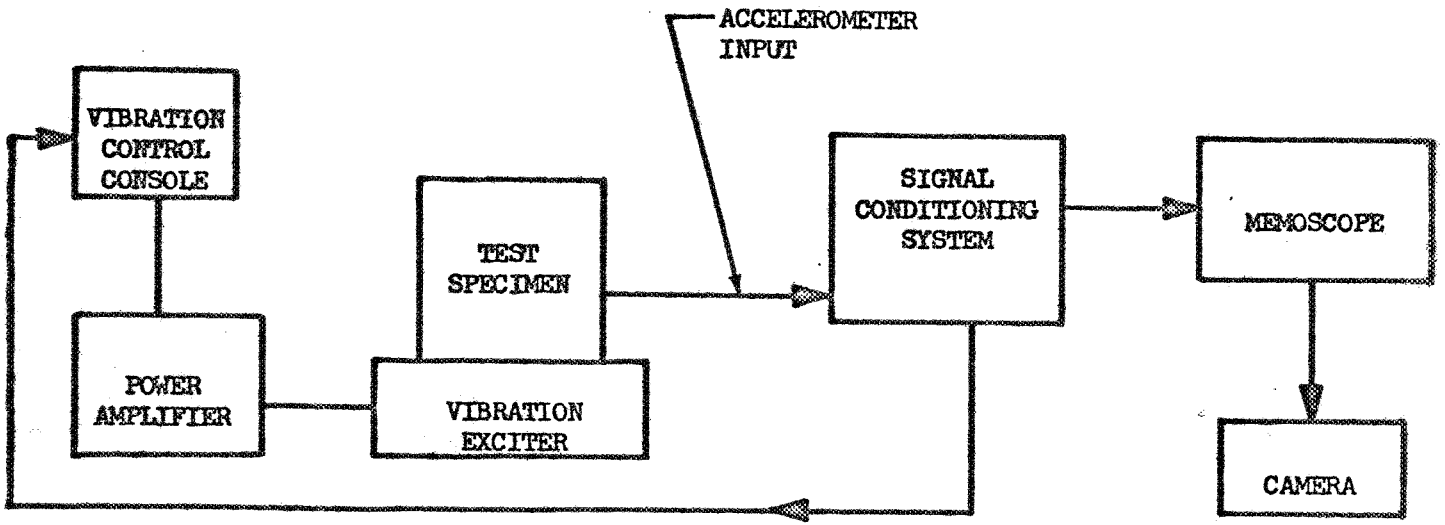
Axes Designation and Accelerometer Locations for Vibration and Shock Tests



Axes Designation and Accelerometer Locations
for Vibration and Shock Tests, View A-A



Vibration Test, Block Diagram



Shock Test, Block Diagram

ADDENDUM D

FAILURE AND REJECTION REPORT;
FAILURE ANALYSIS REPORT

FORM X37-104 (REV. 9-64)

FAILURE AND REJECTION REPORT

PRINT - DO NOT WRITE - USE BLACK BALLPOINT PEN ONLY

DOUGLAS

Page D-10

I- REJECTION

1. REPORT SERIAL NO.: A151137
2. REFERENCE REPORT NO.:
3. DATE: MO. 10 DAY 31 YEAR 66
4. MODEL: DSV4B
5. PART NUMBER: 1A49965-521
CHG.: Y
6. SUPPLIER: Fairchild Hiller CODE: 262026?
7. PART SERIAL NO.: 0201
8. QUANTITY IN LOT: 1
9. QTY. REJECTED: 1
10. PART NAME: LOX CHILL Down Valve
11. MANUFACTURER CODE:
12. REASON FOR REPORT IN DETAIL (NOTE DRAWING OR SPECIFICATION REQUIREMENTS & LOCATION OF DISCREPANCY): IT05783 [illegible] Code 6 Post vibration - Check test in the external leak check the micro switch cover seal had a leakage of 570 sccm, max allowable leakage is 1 sccm.

History: Pre-Test; Proof, External Leakage, Internal Leakage, Actuator Leakage, Functional Test, Ambient Cycle Test, High & Low Temp Cycling 3 Axis Vibration.

BLK 18.5 This is a formal Qualification Test part, Tested at Beech Aircraft, Boulder, Colo.

13. INSTALLED IN (P/N OR NAME): UNIT NO.:
14. CONDITION: .1 [X] TEMPORARY NON-CONFORMANCE; .2 [ ] PERMANENT NON-CONFORMANCE; .3 [ ] CONFORMING BUT UNSATISFACTORY
15. PART OPERATING TIME: .1 HOURS .2 CYCLES
16. PURCHASE ORDER NO.:
17. REC. REGISTER NO.:
18. STATUS: .1 [ ] RECEIVING; .2 [ ] FAB./ASSEM./INST.; .3 [ ] SYSTEM CHECK OUT; .4 [ ] OPERATIONAL; .5 [X] OTHER (EXPL. BLK. 12)
19. F.O. OR ASSEM. JOB NO.: CLEARED [illegible]
20. SHOP ORDER NO.: 5769-6404
21. SOURCE INSPECTED: .1 [X] DACO .2 [ ] GOV'T. .3 [X] OTHER .4 [ ] NO
22. REJECTION CODE: C1C2C92
23. ROUTE TO: A 273
24. DEPT. REJ. IN: A273
25. RESP. "Q" STAMP:
26. RESP. AGENCY: Supplier
27. RESP. CHANGE: A0000
28. RESP. CHANGE APPROVAL: R McDonald 11-1-6
29. REPORTED BY: W. Pitt 10-31-66 726

II- REJECTION CHECK AND APPROVAL

30. APPROVED BY: R McDonald 11-1-66
31. .1 [X] PRELIM. REVIEW .2 [ ] M.R.B. ACTION .3 [ ] R.D.A. ACTION

III- DISPOSITION

32. DEFECT CLASSIFICATION: .1 [ ] CRITICAL .2 [ ] MAJOR .3 [X] MINOR
33. R.D.A. SERIAL NO.:
34. DISPOSITION OF DOUGLAS ITEMS: .1 ACCEPTABLE AS IS QTY. .2 REWORK QTY. .3 SCRAP QTY.
35. DISPOSITION OF VENDOR ITEMS: .1 ACCEPTABLE AS IS QTY. .2 REWORK OR REPLACE QTY. 1 .3 REPLACE ONLY QTY.
36. DISPOSITION AUTHORITY: QUALITY CONTROL: R McDonald 726; ENGINEERING: J Walsh; GOVERNMENT:
37. SPECIFIC INSTRUCTIONS:

Return Unit to Santa Monica CB-260 Attn: J. Brettnacker, A-273 For Resubmit to A-263 Liaison for further disposition.
R [illegible] for J. Walsh A-263 Liaison Engr.
Concur [illegible] A-729 Insp & Test
Further disposition following return of unit to Santa Monica:
1) Rework to applicable drawing and specification requirements or replace.
2) Identify "Test" per SP3141.
3) Supplemental failure analysis shall be required per Form 60-732 attached.
Walsh A263 Liaison 11-1-6
R/W J. Greene A263

37.1 Resulting Classification: None

IV- CORRECTIVE ACTION

38. SUPPLEMENTAL FAIL. ANAL. REQ'D.: .1 [X] YES .2 [ ] NO — BY: J Walsh DATE: 11-1-6
39. CAUSE OF DISCREPANCY: Fairchild Notified 10-31-6 [illegible]
Concur R McDonald 9729
Cause and C/A to be Determined
Ref SFA A151137
40. CLASSIFICATION OF CAUSE OF DISCREPANCY: .1 [ ] DESIGN .2 [ ] MANUFACTURE/HANDLING DAMAGE .3 [ ] MISUSE IN OPERATION — BY:
41. CORRECTIVE ACTION: REF SFA

NOV 18 1966 R/A - C/D A-3

42. C/A EFFECTIVITY: (1)
43. C/A SIGNATURE: DATE:
44. C/A APPROVAL: DATE:

V- DISPOSITION ROUTING

45. PROGRESSIVE RWK. INSP. CHECKS REQ'D.: .1 [ ] YES .2 [X] NO
REFER TO:
46. BONDROOM DISPOSITION:
REPLACEMENT P.O. NO.: 6A-8407
BONDROOM SIGNATURE:
47. REWORK F.O. NO.:
PLANNER:
48.

VI- REJECTION CLEARANCE

49. M.R.B. RESUBMIT (ENG'G):
50. REWORK ACCEPTANCE AND/OR REJECTION CLEARANCE: PRODUCTION / QUALITY CONTROL / GOVERNMENT

VII- OTHER FUNCTIONS

51. TERM. STOCKROOM: CB 260
52. REPL. QTY. NEEDED:
53. ACT. UNIT SHORT:
54. PROD. CONT. SIGNATURE:
DATE:
55.
56.

PAGE 1 OF 2

SM C 2C(?)
FORM 37-104C (5-65)
SM-9-(?) DSV4B

F.R.R. SUPPLEMENT

18. REPORT SERIAL NO.	57. NEXT ASSEMBLY NAME	58. NEXT ASSY. SN	59. NEXT ASSEMBLY PN	CL
A151137			1A49965-521 Lox Chill Down Valve	

60. N.A. REF. DES.	61. NEXT ASSEMBLY MANUFACTURER	CODE

SUBSYSTEM NAME	CODE	64. F.I. REF. DES.	65. FAIL.	CODE

66. REFERENCE DOCUMENTS
SCD# 1A49965   TPD# 1T67722

62. SPECIAL TESTS
1. ☐ RESEARCH
2. ☐ DEVELOPMENT
3. ☐ DESIGN APPROVAL
4. ☐ ACCEPTANCE
5. ☒ FORMAL QUALIFICATION
6. ☐ RELIABILITY VERIFICATION
7. ☐ ENVIRONMENTAL

67. TECHNICAL INVESTIGATION

1. FORMAL QUAL LINE ITEM FQ14A, CODE 6, SM141412 CTP.

2. FLIGHT CRITICAL ITEM

3. CONTACT J. GILLESPIE, A863
   A. LOUPE, A663
   P. CHRISTOPHAS A863
   G. ALBANO, A3-863.

4. SFA REQUESTED BY J GILLESPIE APPROVED BY A. LOUPE
   To be conducted at Supplier Location,
   J. HOGAN, A3-863 WITNESS.

5. REF FOLLOWING PRIOR REJECTIONS:

-503	A157815	-1M0004	POSITION INDICATOR
"	A120753	"	MAIN VALVE LEAK
-505	A120762	0005	INT ACT LEAK
-511	A174578	107	ACTUATION
"	A185142	"	RUPTURE (BELLOWS)
"	A185970	0004	WOULDN'T CLOSE, POSITION
-515	A212863	204	ERRATIC RESPONSE
"	A212869	"	INT. LEAK
"	A212883	"	INT. LEAK

6. REF SEO 1A49965—1025 FOR RETURN TO SUPPLIER

69. REPORTED BY	DEPT.	TEL. EXT.	56C.
J. Walsh 11-1-6	A263LIA	3982	PAGE 2 OF 2

FAILURE ANALYSIS REPORT
A151137/1A49965-521
Lox Chill Down Valve
Model DSV-4B

INITIATED: 10-31-66

COMPLETED: 12-2-66

FAILURE ANALYSIS COMMITTEE
ACTIVITY COMPLETE 12-2-66
Date

H. L. Howard A3-7413
Reliability Assurance Dept.

G. R. Williams A263
Development Engineering Dept.

F. L. Quilly
Reliability Engineering Dept.

W. W. Pearce 12-7-66

DOUGLAS

DOUGLAS MISSILE & SPACE SYSTEMS DIVISION

SHEET 1 OF 12

INTERIM REPORT 11/9/66

REPORT NUMBER 1	DATE 2	DAC MODEL 4	MANUFACTURERS PART NO. 5	C/L	SERIAL NO. 13	
A151137	10 31 6	D3V-4B	1A49965-521		0201	

DAC PROCUREMENT DRAWING 15	PART MANUFACTURERS NAME 6	PART NAME 9
1A49965	Fairchild-Hiller	Lox Chill Down Valve

SUPPLEMENTAL FAILURE ANALYSIS REPORT

DOUGLAS MISSILE & SPACE SYSTEMS DIVISION
FORM 60-732 (REV. 9-62)

ESTABLISHED CAUSE 14
- ☐ DESIGN
- ☐ MANUFACTURING
- ☒ MISUSE DAC

Coordinated with A. Loupe, A-863

A FAILURE HISTORY: Formal Qual Test Part, Item No. FQF14A, Type 6. During Test Per SCD #1A49965 and TPD #1T07783, the Micro Switch Cover Seal Leaked at the rate of 570 SCCM; Maximum leakage allowable is one SCCH. Unit has been subjected to: Pre-Test Inspection, Proof and leakage ~~pressure~~ Functional including Electrical Tests, ~~Low Temp Vacuum Flow Thermal Shock~~, Vibration and Post Vibration and Mechanical Shock Test.

For reference to earlier failures, See FRR Supplement.

B INSTRUCTIONS FOR ANALYSIS:

(1) The Supplier shall conduct a Failure Analysis to determine failure mechanism and cause. A Douglas MSSD Development Engineering Representative shall witness the Failure Analysis. Completion of this analysis is required prior to 11-14-66.

(2) Test to verify malfunction. Disassemble as required to determine the cause of failure. Evaluate and record all findings.

(3) In the event the failure mechanism, per this Analysis, is attributed to contamination (foreign material), then supporting evidence shall be submitted as a part of this Analysis, as to the nature, particle size, and particly count of material preventing performance of the unit within specification. If Supplier does not have capability for such Analysis, the suspect material should be collected, identified as to area and location found, and forwarded to DAC referencing this report number.

(4) Supplier shall complete items C and D. All Photos, Data Sheets, Work Sheets and/or generated data per this Failure Analysis shall be attached to and become a permanent part of this report, and should be noted on this form.

AUTHORIZED BY _____ DEPT _____

C FAILURE ANALYSIS:

(5) When the Analysis indicates that Supplier Action is required to prevent recurrence of noted discrepancies, a positive course of action shall be noted in Itme E by Supplier.

(6) Comply with Failure Analysis REquirements of 1A86975 Reliability Requirements Specifications.

(CONCLUSIONS, RECOMMENDATIONS AND ACTION ON PART 2)

INTERIM REPORT 11/9/66

FORM 60-733-1 (REV. 11-62)

REPORT NUMBER		SERIAL NO.	PART 2
A151137 1	SUPPLEMENTAL FAILURE ANALYSIS REPORT	0201 13	

DOUGLAS MISSILE & SPACE SYSTEMS DIVISION

FORM 60-733 (REV. 9-62) (CONTINUED)

C FAILURE ANALYSIS (CONTINUED):

B INSTRUCTIONS FOR ANALYSIS Con't.

(7) Return the completed report to: Douglas Aircraft Co., Inc.
3000 Ocean Park Blvd.
Santa Monica, California 90406
Attn: W. C. Jenkins, A-165

(8) Failure Analysis Unit coordinate Analysis with J. Hogan A3-863, Ext. 2537

AUTHORIZED BY [signature] Dept. A263
Engineering Liaison
Failure Analysis Unit, Ext. 3982

D CONCLUSIONS:

C FAILURE ANALYSIS: The unit was disassembled and tested at Stratos, 2 November, in the presence of D.A.C. personnel Jack Hogan, Dick Starr, and John Turner.
Bellows 66-019 was removed from the valve and tested at 100 psig actuator pressure. Leakage occurred at the gasket of the switch cover.
The inner-bellows was separated from the assembly and maintained intact. Six psig was applied with the bellows submerged in alcohol. Leakage occurred at the O.D. of convolution number 19 as counted from the threaded end.

The bellows parts were given to Mr. Hogan for the purpose of obtaining adequate photographs. These photos show the flat spot and cracks at the point of leakage. A new bellows was assigned to the valve for assembly, test, and shipment.

On Nov. 8, the following persons met at the bellows vendor, Aeroflex. DAC personnel, Jack Hogan, Joey Kumagai, John Moynihan. BY _____ DATE _____
ATTENDANCE: Aeroflex personnel, Clarence Ross, Chief Engr, Dale Van Winkle, Q.C. Mgr.
Stratos personnel, Roy Smith, Reliability Engineer.

Manufacturing and Q.C. processes were thoroughly reviewed. A shop tour was conducted and processing was described. The inner bellows was cut apart longitudinally disclosing a crack in one convolution of the inner ply, and a small crater in the seam weld of the inner ply. The outer bellows was removed from the housing and a small crater was found in the seam weld of the outer ply. Evidence was found indicating possible slight contact between the O.D. of each bellows and the adjacent enclosure.
By _____ Date _____

The cause of the flat spot, cracks, and leakage at the inner bellows could not be positively assigned. Possibilities are, 1) rubbing on the adjacent enclosure, 2) minor damage during fabrication. It was agreed that the noted discrepancies could be missed during visual inspection and that thinness of the material (.007") might make X-ray detection of the craters questionable.

Projected Actions:
1. Aeroflex will submit revised procedures for approval. Revision will include closer visual inspection at increased magnification.
2. D.A.C. (J. Kumagai) will conduct electron microscope examination and metallurgical analysis of the discrepant parts.
3. Additional information will be submitted when available. By W. Smith, Stratos 11/9/66

SE ? INTERIM REPORT. 11/16/66

REPORT NUMBER A151137

SUPPLEMENTAL FAILURE ANALYSIS REPORT

DOUGLAS MISSILE & SPACE SYSTEMS DIVISION

FORM 90-1 (REV. 5-65) (CONTINUED)

SERIAL NO. 0201

PART 3

Results of microscopic/metallurgical analysis conducted at D.A.C. by J. Kumagai, Materials & Process Engineer.

1. Analysis disclosed that the failed convolution had made contact with the wall of the bellows enclosure during the vibration test. Contact resulted in plastic deformation of the convolution and produced the observed flat spot. Subsequent operation of the valve induced the cracks which propagated from the flat spot.

2. Investigation of test records disclosed that, during the sine sweep from 5 to 1000 cps, the applied g-load in the radial direction was approximately twice the value required by specification. It was also determined that the alignment of the excessive g-load coincided with the circumferential location of the flat spot on the convolution.

D. CONCLUSIONS:

The failure resulted from application of excessive g-load during vibration at the test facility.

E. ACTION TAKEN:

1. No action required by Stratos on the basic cause of failure.
2. Tightening of inspection at and by bellows vendor, Aeroflex, is in process of instigation. Final submittal of this SFAR will be made as soon as the revised procedures have been fully defined and approved and the effectivity has been identified.

R.K. Smith 11/16/66

REPORT NUMBER A151137 1

SUPPLEMENTAL FAILURE ANALYSIS REPORT

DOUGLAS MISSILE & SPACE SYSTEMS DIVISION

FORM 60-732 (REV. 9-62) (CONTINUED)

SERIAL NO. Page D-7 0201 13

PART 2

C FAILURE ANALYSIS (CONTINUED):

See Attached Sheets

BY _____ DATE _____

D CONCLUSIONS:

Poor quality control on the part of the bellows manufacturer was initially thought to be the major contributing factor in the bellows failure, however, the results of the metalurgical analysis performed by MR&PM on the failed bellows assembly has revealed that the inner bellows did, in fact, contact the wall of its container during vibration. Microscopic examination of the deformed convolute in the middle of this bellows showed evidence of fretting and plastic deformation as the result of contact with the container.

The bellows container was sectioned in two and examined under magnification. The distance from the end and the location of the bellows deformed convolute coincided with the marks found in the container.

The orientation of the damaged bellows convolution and the container marks coincided with the radial axis "B" of vibration. Examination of the vibration test data indicates over vibration beyond specification by 70 to 100 % in radial axis "B". This overvibration occurred during the sinusoidal up sweep from 100 to 1000 cps due to the low temperature response of the control accelerometer (see attached graph of accelerometer #3 and #4 up sweep vs down sweep 100 to 1000 cps).

It is evident that the overvibration levels were responsible for this bellows failure based on the examination of the valve, valve bellows and the review of these vibration test data.

E ACTION TAKEN:

Corrective action was taken to replace the accelerometer with one of the proper type.

This test specimen valve body for FQ-F14A has been refurbished with a new bellows assembly and has successfully completed life cycle and vibration at Beech Colorado.

F14 Fuel Shutoff Valve has also completed both life cycle and vibration with the same bellows configuration.

BY R. A. Allen DATE 11/30

F14C is equivalent to the 1A49965-519 LH_2 Chilldown Shutoff Valve.

F14 is equivalent to the 1A49965-519 LH_2 Chill System Shutoff Valve.

F14A is the 1A49965-521 LO_2 Chilldown Shutoff Valve, the only difference being in the body casting configuration.

FQ-F14A was subjected to overvibration in the sine sweep at 5-1000 cps by a factor of 2. This was due to an accelerometer that would not take the -300°F temperature. The overvibration was in the direction of axis "B".

JH/rs

Copies to:

W. S. O'Hare, A3-860
C. C. Moebius, A3-860
J. M. Gunn, A3-860
D. T. Erickson, A3-860
R. E. Overman, A3-860
D. Beck, A3-860
C. M. Hansen, A3-863
A. Loupe, A-860
A. J. Haupt, A-860
J. Green, A-860

RECORD OF DISCUSSION

DATE [illegible]

GENERAL SUBJECT [illegible]

PERSON OR COMPANY CONTACT: Fairchild [illegible]

SUBJECT OF DISCUSSION: Inner bellows [illegible] leaking during firewall qualification vibration tests. Bellows S/N [illegible] Valve S/N [illegible]
Ref: Memorandum A3-860-KC20-M-79

DECISIONS OR AGREEMENTS: With the [illegible] pressurization to the actuator inlet port leakage exceeded [illegible]. To isolate the source between the inner and outer bellows [illegible] was applied to the actuator switch housing at which time a blowing leak was observed from the microswitch gasket area. The valve was rejected (Fail [illegible]) at Beech Aircraft Co., Colorado and returned to Santa Monica "A" Plant.

The valve with the necessary paperwork was [illegible] taken to Fairchild Hiller, Manhattan Beach. Repeating the test at Fairchild, the actuator was pressurized to [illegible] air with ambient helium gas and bubble [illegible] to the switch housing gasket area showing a blowing leak. The switch housing was removed and a rubber tube placed over the actuator shaft to isolate the leak as between the bellows and the bellows weld joint. The leak was verified to be within the convoluted section of the bellows.

The inner bellows was removed from the container and pressurized to [illegible] psig with helium gas. Submerging the pressurized bellows in alcohol revealed a spewing leak in convolution #18 in the center of the bellows. The leaking area was examined with a 60X power scope showing local deformation and abrasion of the convolution and the resultant leak path cracks.

The following action will be taken on the results of the failure experienced:

1. The bellows manufacturer "Aeroflex", El Cajon, California, will be visited to review the following:

   A. Examination of bellows fabrication and assembly techniques.
   B. Examination of yet assembled bellows.
   C. Quality control practices.
   D. Review of the paper work involved in the assembly and fabrication of the failed bellows S/N 018.

2. A new valve will be procured or the existing valve body refurbished with a new bellows and retested to the requirements of F14A.

The F14C valve with the same bellows configuration, after being subjected to both life cycle and vibration shows no bellows leakage.

The valve with the same bellows configuration also does not show any leakage after being subjected to both life cycle and vibration.

(Continued on Page 2)

SIGNED J. Green

Copies to:

[illegible], A3-863
A. D. [illegible], A3-863
[illegible], A3-863
D. [illegible], A3-8[illegible]
C. W. [illegible], A3-863
J. Lew, A3-863
[illegible] Overman, A3-863
D. W. Erickson, [illegible]
A. J. [illegible], A-[illegible]
J. Kumagai, A3-863

RECORD OF DISCUSSION ROD # 617

11-18-66

CHILL SYSTEM SHUTOFF VALVE (F14A)

PERSON OR COMPANY CONTACTED: J. Lew, A3-863; J. Kumagai, A3-263

SUBJECT OF DISCUSSION: Inner Bellows Failure of F14A S/N0201

Ref: FARR #A151137, Memorandum A3-860-KCEO-M-795; A3-860-KCCG-M- ROD #575 and ROD-AFD2-0097

DECISIONS OR CONCLUSIONS: The results of the metalurgical analysis performed by MR&PM on the failed bellows assembly has revealed that the inner bellows did, in fact, contact the wall of its container during vibration. Microscopic examination of the deformed convolute in the middle of this bellows showed evidence of fretting and plastic deformation as the result of contact with the container.

The bellows container was sectioned in two and examined under magnification. The distance from the end and the location of the bellows deformed convolute coincided with the marks found in the container.

The orientation of the damaged bellows convolution and the container marks coincided with the radial axis "B" of vibration. Examination of the vibration test data indicates over vibration beyond specification by 70 to 100 % in radial axis "B". This overvibration occurred during the sinusoidal up sweep from 100 to 1000 cps due to the low temperature response of the control accelerometer (see attached graph of accelerometer #3 and #4 up sweep vs down sweep 100 to 1000 cps).

It is evident that the overvibration levels were responsible for this bellows failure based on the examination of the valve, valve bellows and the review of these vibration test data.

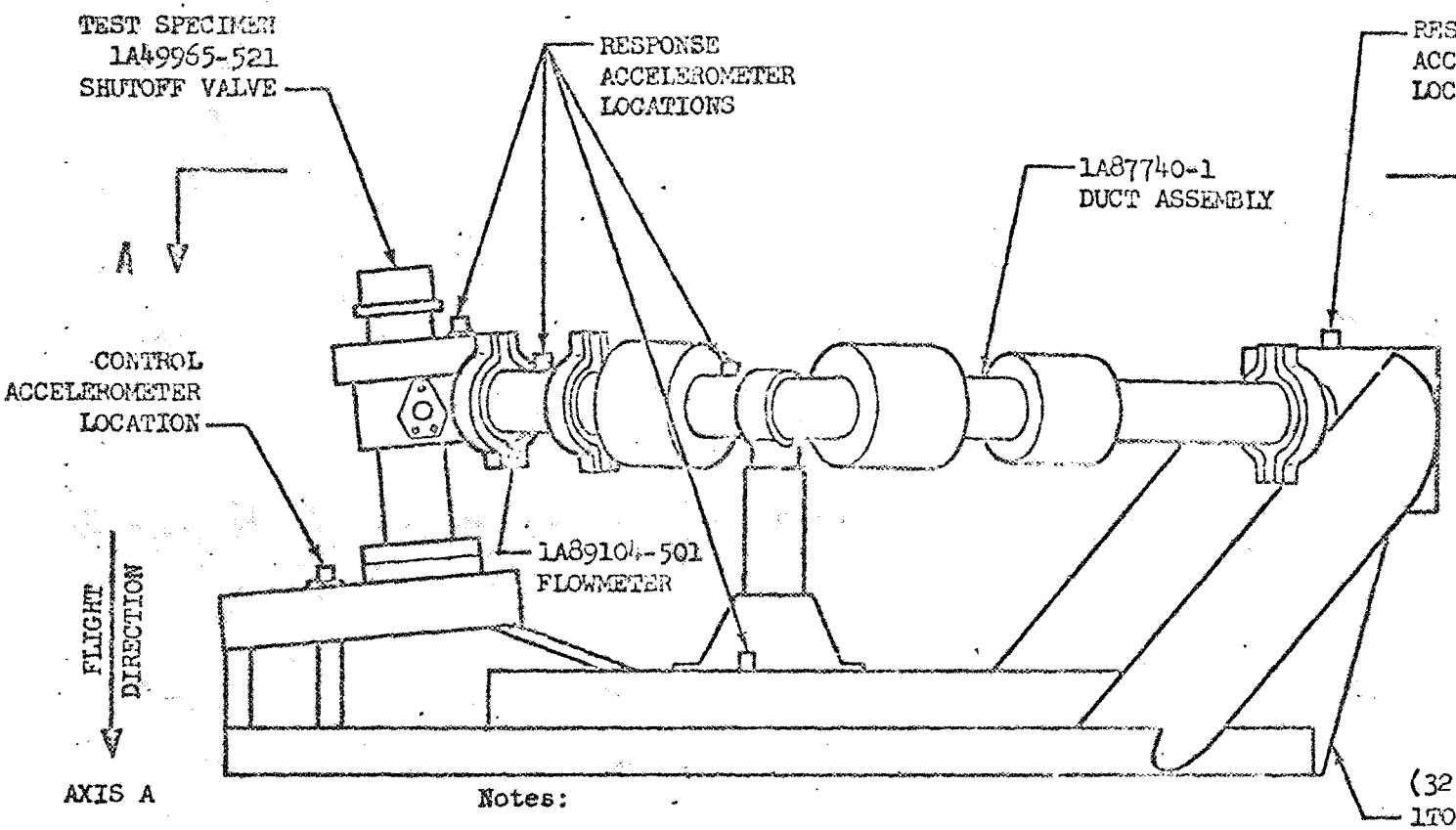
Based on this failure analysis redesign will not be considered.

This test specimen valve body for FQ-F14A has been refurbished with a new bellows assembly and has successfully completed life cycle and vibration at Beech Colorado.

F14 Fuel Shutoff Valve has also completed both life cycle and vibration with the same bellows configuration.

SIGNED: J. Hogan
J. Hogan
Propulsion Design
Saturn Propulsion Department

JH/rw



Notes:

1. Accelerometer locations are the same for all axes.
2. Response accelerometers are oriented in the direction of vibration or shock.
3. View A-A is shown in figure 12.

Figure 11. Axes Designation and Accelerometer Locations for Vibration and Shock Tests

FORM X??? (10-62)

SYM C

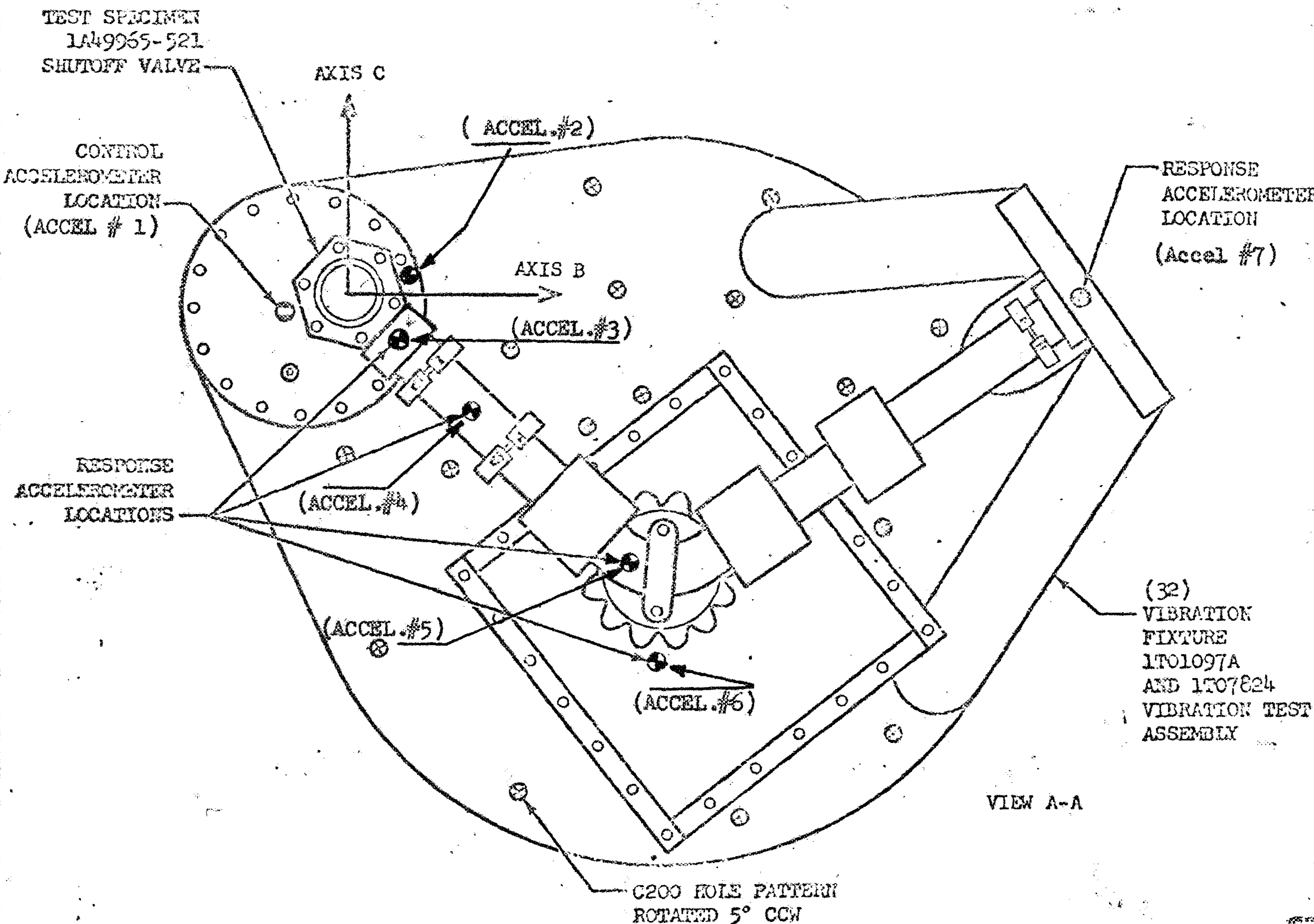
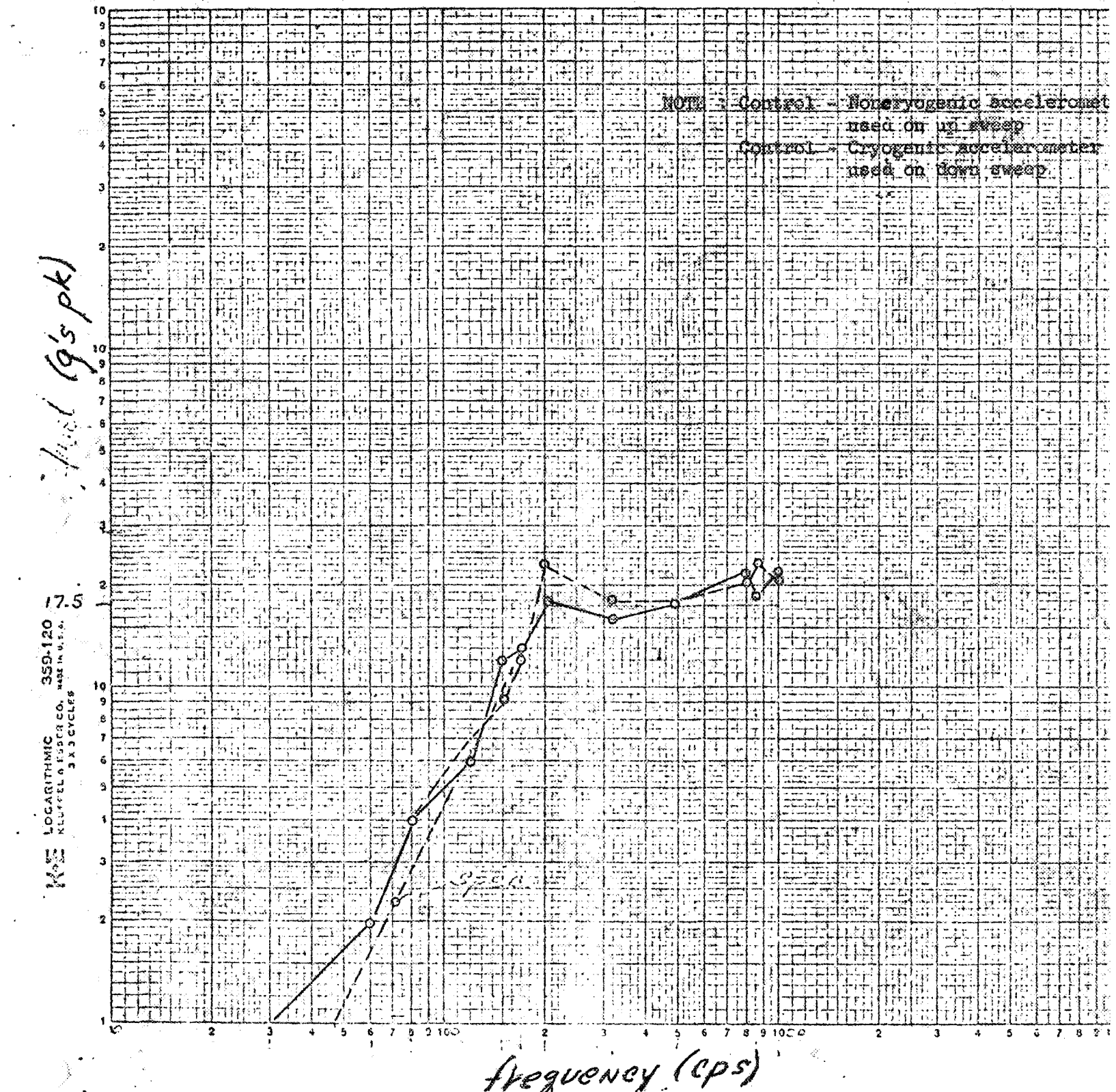


Figure 12. Axes Designation and Accelerometer Locations for Vibration and Shock Tests, View A-A

DOUGLAS AIRCRAFT COMPANY, INC	CODE IDENT NO. 18355	SIZE A	1T07783
			SHEET 46

FQ-F14A
10-28-66

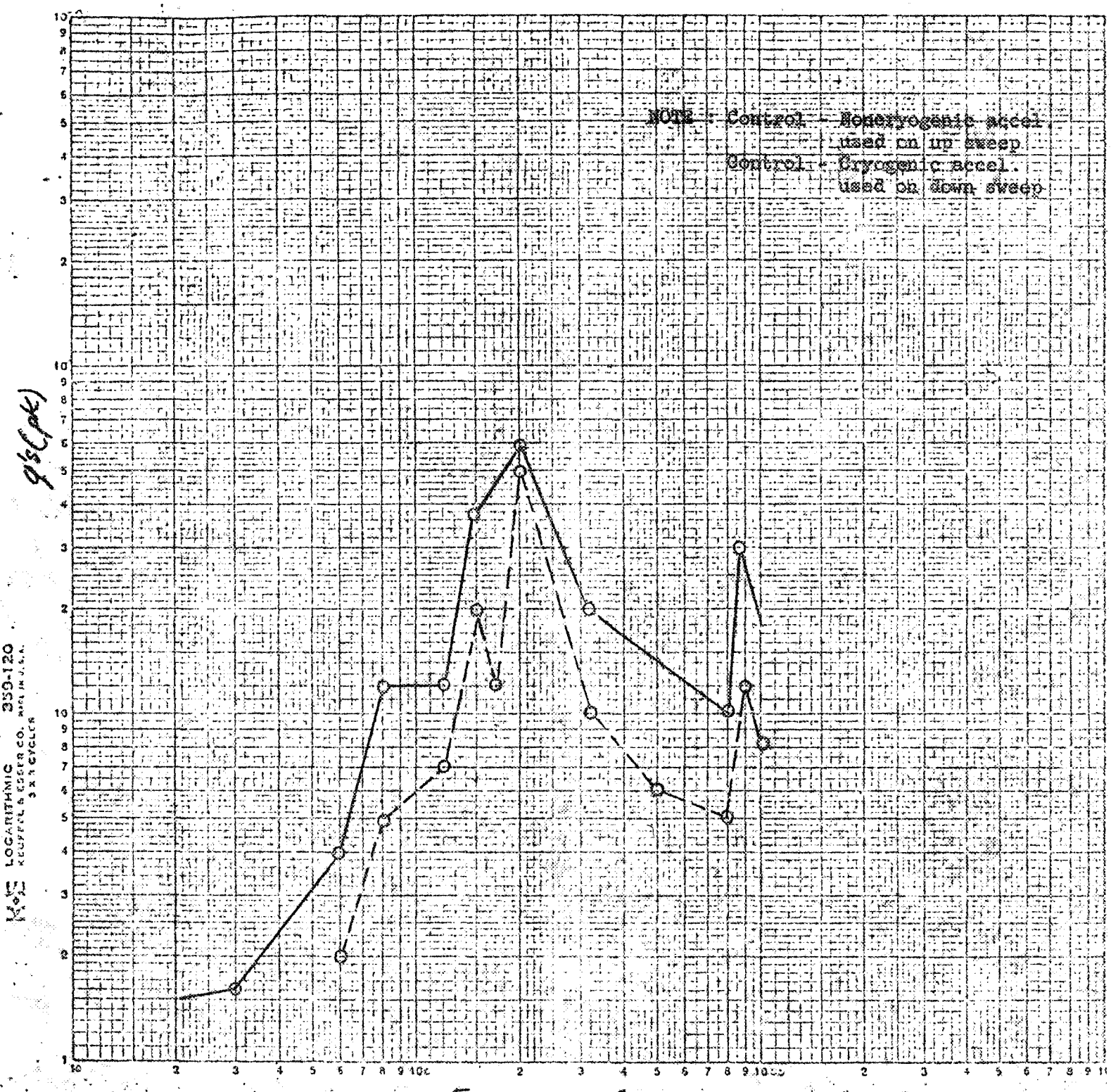
RADIAL AXIS
Accel. #1
Unfiltered
_____ Upsweep
_ _ _ _ Downsweep



Sweep 10

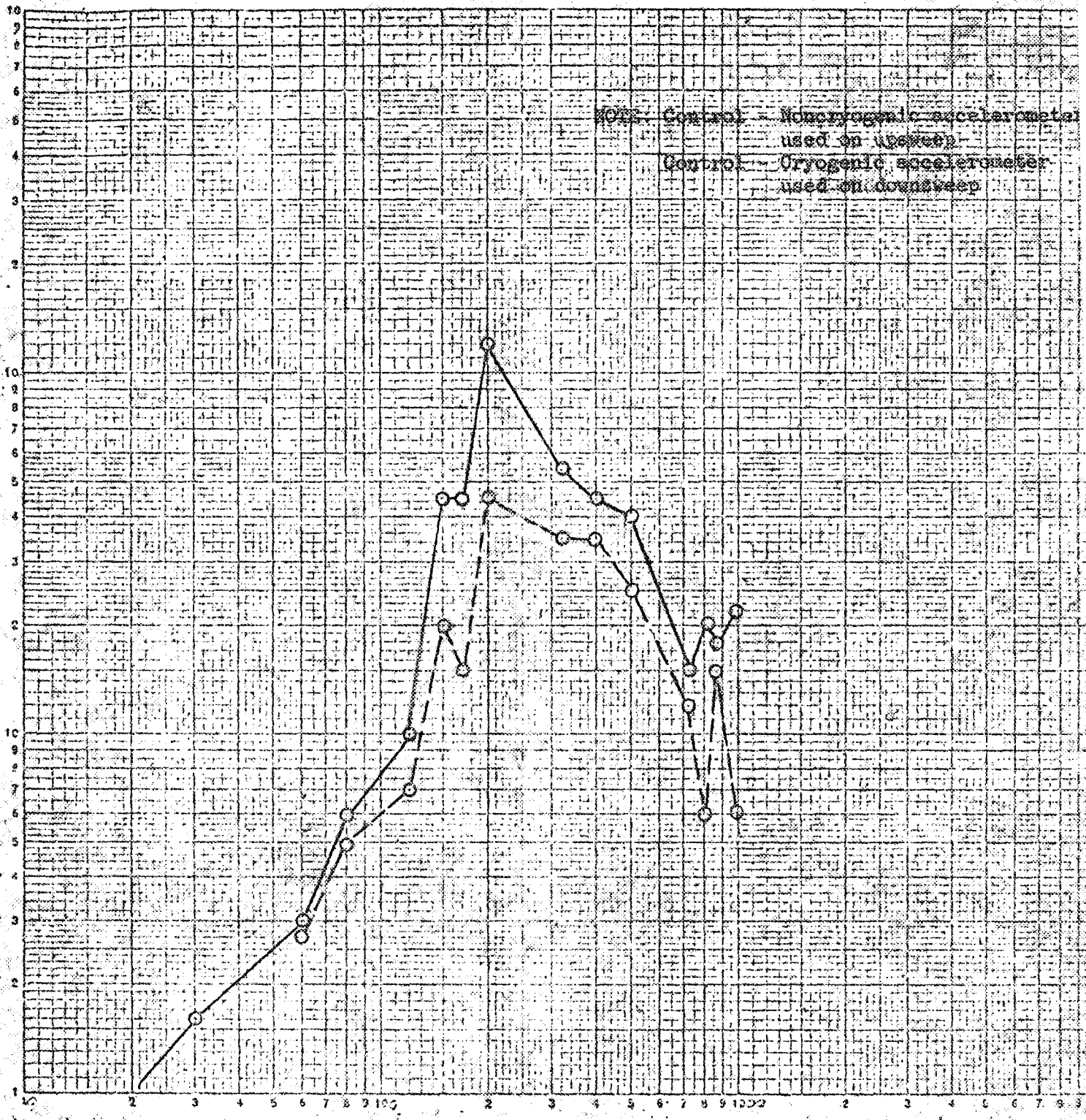
FQ-F14A
10-28-66

Accel #3
_____ upsweep
_ _ _ _ DOWNSWEEP



FQF19A
10-28-66

RADIAL AXIS
Accel #4
_____ Upsw
- - - - Dow



SHEET 12

Filtered
_____ Upsweep
_ _ _ _ _ Down

RADIAL AXIS

ACCELEROMETER #1

Accel. (g's pk)

Model Control - NonCryogenic accelerometer used on upsweep
Control - Cryogenic accelerometer used on downsweep

Spec.

frequency (cps)

Test Equipment List

Test Plan Line Item: FQ-F-14A

Test Equipment Name	Mfg. and Model No.	Serial No. Tag No.	Range	Accuracy	Calibration Date	
					Last	Next
Pressure Gage	U. S. Gauge	--	0 to 1000 psig	±0.5% F.S.		
Pressure Gage	Heise	--	0 to 400 psig	±0.1% F.S.		
Pressure Gage	U. S. Gage	--	0 to 160 psig	±0.5% F.S.		
Transducer	Taber 185-SA	185-SA	0 to 1000 psig	±1.0%		
Transducer	Taber Teledyne	--	0 to 500 psig	±1.0%		
Transducer	Taber Teledyne	--	0 to 100 psig	±1.0%		
Differential Pressure Transducer	Statham	--	0 to 1 psid	±1.0%		
Flowmeter	Waugh FB-20	12433	0 to 100 gpm	±2%		
Temperature Recorder	Brown, 153X67 P12H-11-111-106	LOR2264	±300°F	±2°F		
Temperature Recorder	Westronics 41-3938	M5A065	±150°F	±5°F		

Comments: _____

Test Equipment List

Test Plan Line Item: FQ-F-14A

Test Equipment Name	Mfg. and Model No.	Serial No. Tag No.	Range	Accuracy	Calibration Date	
					Last	Next
Oscillograph Recorder	Honeywell 906B	9-7279	As Calibrated	±2%		
Oscillograph Recorder	Honeywell 906C	9-9592	As Calibrated	±2%		
Tape Recorder	Ampex FR1200	7040125	0-300 KC	N/A		
Charge Amplifier	Unholtz-Dickie	Cabinet No. 1	--	--		
Charge Amplifier	Unholtz-Dickie	Cabinet No. 2	--	--		
Meter, True RMS	Ballantine	4839	0-5	±.5%		
Digital Voltmeter	Dana 5100	031238	1 MV - 1 KV	±0.01%		
Differential D. C. Voltmeter	John Fluke 801	3899	0-500 V	±0.05%		
Wheatstone Bridge	Industrial Inst. RW-2	10072N	--	--		
Hypot	4003-M7 Associated Research	76	Alarm Set at 200 μa	±.3%		

Comments:

Test Equipment List

Test Plan Line Item: FQ-F-14A

Test Equipment Name	Mfg. and Model No.	Serial No. Tag No.	Range	Accuracy	Calibration Date	
					Last	Next
Megger	General Radio	--	0-500	±1%		
Bridge Balance	Beech Aircraft Company	--	N/A	N/A		
D.C. Power Supply	Sorenson Nobatron RC-36-30	L-18	0-36 V & 0-30A	N/A		
Leak Detector	Veeco MS9AB	MS412	10^{-4} to 10^{-10} std. cc He/sec	±10%		
Leak Detector	Veeco MS9AB	MS11223	10^{-4} to 10^{-10} std. cc He/sec	±10%		
Environmental Chamber	Consolidated Vacuum C. E. Howard, 304	8581	-300 to +400°F Atm to 10^{-5} mm Hg	N/A		
Ionization Vacuum Gage	Varian 9710003	1060	10^{-4} to 10^{-11} mm Hg	10%		
Vacuum Monitor	Varian G-11A	6855	0-10	±1/2%		
Mechanical Vacuum Pump	W. M. Welch Duo-Seal	24529	1 x 10^{-4} mm Hg	N/A		
Filter	Vacco Valve Company	F15779-6	10 micron	N/A		

Comments:

Test Equipment List

Test Plan Line Item: FQ-P-14A

Test Equipment Name	Mfg. and Model No.	Serial No. Tag No.	Range	Accuracy	Calibration Date	
					Last	Next
Filter	Western Filter 28-1-10510	035509	10 micron	N/A		
Filter	Western Filter 28-1-10510-2	1035436	2 micron	N/A		
Pressure Regulator	Victor Equipment Co.	8510	3600 out 7000 in	N/A		
Pressure Regulator	Victor Equipment Co.	40403	10,000 in 200-10,000 out	N/A		
Relief Valve	Republic Valve 640XB-10-4-T	CLB-1330	800 psig	N/A		
Relief Valve	Republic Valve 640XB-10-4-T	CLB-1331	200 psig	N/A		
Hand Valve	Robbins - 1/2 Inch	G500A	0-6000 psig	N/A		
Hand Valve	Robbins - 1/2 Inch	0375A	0-6000 psig	N/A		
Cryogenic Hand Valve	Pacific Valve 8005 - 1/2 Inch	316	0-1000 psig	N/A		
Hand Valve	Robbins - 1/4 Inch	--	0-6000 psig	N/A		

Comments:

Test Equipment List

Test Plan Line Item: FQ-F-14A

Test Equipment Name	Mfg. and Model No.	Serial No. Tag No.	Range	Accuracy	Calibration Date	
					Last	Next
Solenoid Valve	Marotta 3-way	--	0-3000 psig	N/A		
Vibration Fixture	Douglas Aircraft	N/A	N/A	N/A		
Wire Harness	Douglas Aircraft	N/A	N/A	N/A		
Electronics Counter	H-P 500B	015-03679	0-100 KC	2%		
Pressure Transducer	Statham PA324TCe-1250-380-13831	1399	0-1250 psig	1.0%		
Pressure Gage	Heise H-44108	N/A	0-2500 psig	0.1%		

Comments:

FORM 850-2 (11-66)

DOUGLAS AIRCRAFT CO, INC. MISSILE & SPACE SYSTEMS DIVISION SANTA MONICA, CALIFORNIA	QUALIFICATION STATEMENT	☐ DE/Q TEST ☒ FORMAL QUAL
PROGRAM Saturn	TEST PLAN AND ITEM NUMBER FQ-F-14A DAC 56625	
TEST PLAN LINE ITEM TITLE SHUTOFF VALVE, LO_2 CHILLDOWN SYSTEM	PART NO. 1A49965-521Y 1A49965-521AA 1A49965-521-011AC	
TECHNICAL MEMORANDUM NUMBER(S)	TM-DSV4B-ENV-R5924 Rev A (S/N 0201); TM-DSV-4B-(SSL)-PL-R-6092-2 (S/N 0206); TM-DSV4B-ENV-R5929 (S/N 0201; TM-DSV-4B-ENV-R6092-1 (S/N 0002, 0206); TM-DSV4B-PROP-R6092 (S/N 0002, 0206)	

ENGINEERING RESOLUTIONS AND CONCLUSIONS

The LO_2 Chilldown System Shutoff Valve, P/N 1A49965-521 and -521-011, successfully met the requirements of TCD 1T07782, Revision J, when tested in accordance with TPD 1T07783, Revision M, except as noted below:

S/N 0201 (-521): A bellows failure was caused by vibration of 70 to 100% above required levels as a result of low temperature problem with control accelerometer. Retest with new bellows installed were satisfactory. (Ref. FARR A151137)

S/N 0002 (-521): An external leakage rate of 41.5 scch occurred during post vibration (1 scch max. allowable). The actuator subassembly screws were retorqued and retest was satisfactory. The flow test pressure drop was 0.31 psid; however, the limit was increased from 0.25 to 0.50 psid, maximum. Two position indication switches gave erratic talkback during tests. The -525 configuration (-521-011) incorporated an improved open switch actuator. Also, a higher reliability microswitch (1HM25) is now being used. (Ref. FARR A240388).

S/N 0206 (-521-011): A force of 34 pounds was required to move the actuator from normal unpressurized position to full open position; however, the limit was increased from 30 to 35 pounds. Excessive internal leakages up to

(USE CONTINUATION SHEET AS NECESSARY)

STATEMENT OF QUALIFICATION

Based on the Formal Qualification Test results presented in the attached report, it is the conclusion of the Douglas Aircraft Company, Inc., that the above item continues to be qualified for use as intended on the Saturn SIVB.

DESIGN TECHNOLOGY	RELIABILITY ENGINEERING	PROJECT OFFICE-TEST
5-16-68 P.S.F. Peter Kroth for D. D. Hofferth Chief Engineer Saturn Propulsion	6/24/68 6-13-68	5-20-68 H B Mitchell

FQ F-14A

FQ-F-14A

ENGINEERING RESOLUTIONS
AND CONCLUSIONS

S/N 0206: (-521-011) 1600 scim (maximum allowable 100 scim) were noted during thermal vacuum test and post repeat cycle test. Leakage was attributed to a lip (a result of incomplete material removal during machining) on the inner diameter of the poppet seal. Replacement of the seal by DAC resulted in acceptable leakage when chilled down in closed position as in vehicle usage; however, leakage was still excessive when chilled down in the open position per test procedure. This seal lacked a truing cut usually performed on seal and retainer assembly prior to installation. Replacement with seal and retainer assembly having a truing cut corrected leakage problem. (Ref. FARR's A240391 and A240398).

The -521-011 configuration has a redesigned switch actuator and a sealant on the switch cover and electrical connector and is identical to the -525 configuration.